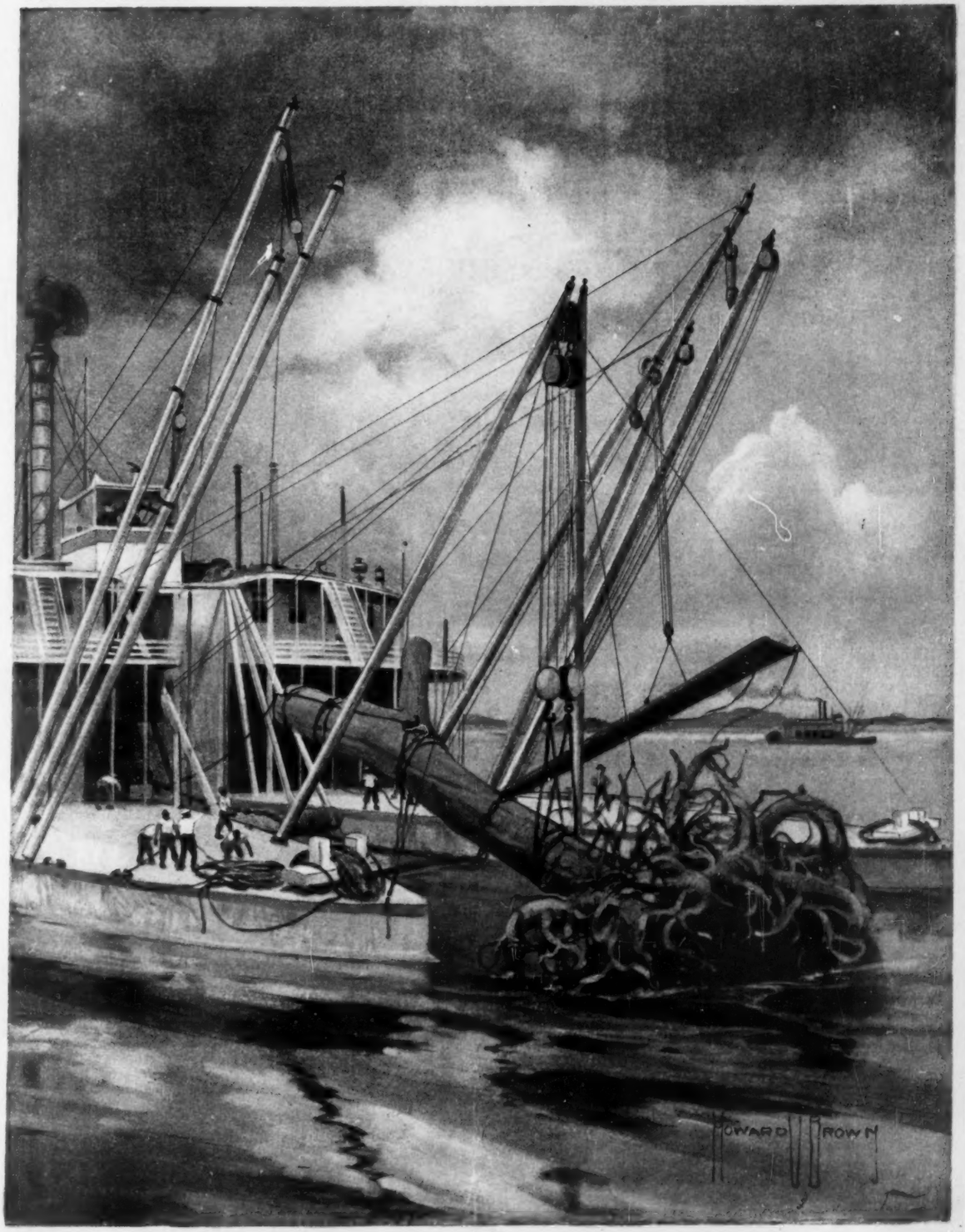
IN THIS ISSUE:

MOLYBDENUM STEEL IN THE MOTOR CAR
WHAT MAKES THE GLOW-WORM GLOW?

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



PULLING THE MISSISSIPPI'S TEETH: HAULING A HEAVY SNAG ABOARD.—[See page 60]

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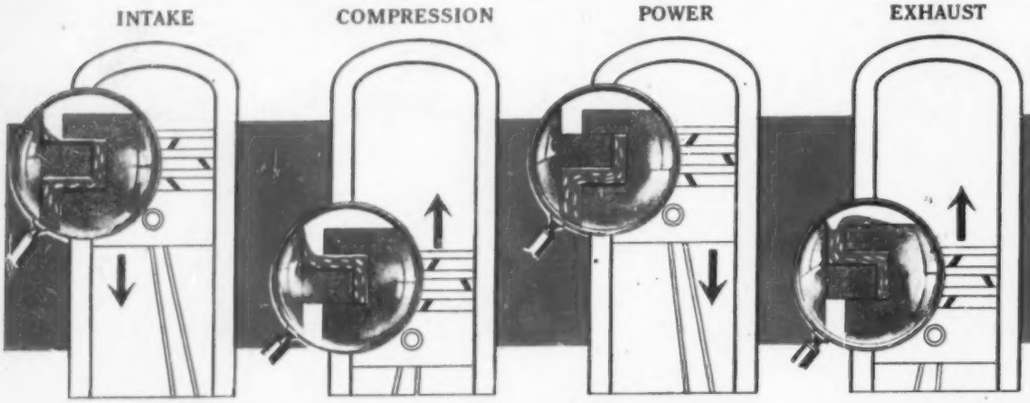

NO

Heavier Oil can never replace metal worn away

YOU are sometimes advised: "As your automobile engine becomes worn use a heavier oil." Heavier oil, some people will tell you, provides a better seal for clearances enlarged through wear.

But first consider these facts:

As your car grows older, metal is worn away by the wear between moving surfaces. Will heavier oil replace this lost metal? NO.

The oiling system of your engine was designed specifically to circulate lubricating oil of a certain body. Will this oiling system—pump, screen, oil pipes, etc.—distribute as effectively a heavier oil? NO.

Any oil, whether heavy or light, when used in worn engines will work past the pistons and piston rings and enter the combustion chambers, forming carbon. The heavier the oil, the more aggravated will usually be the carbon deposit.

What are the wise and only proper measures to take when your engine is badly worn? Obviously, have the bearings adjusted, have new pistons and piston rings fitted, and *continue to use the correct grade of oil for which your engine and oiling system were designed.*

WORN RINGS
cause Carbon Deposits

Worn piston rings move perceptibly upward on the down stroke of the piston; the oil accumulates under and behind the rings. Then as the piston moves upward the rings move to the bottom of the recess, forcing the oil by the rings. This is sometimes termed "oil pumping." The oil ultimately reaches the combustion chamber causing carbon deposit.

This whole subject of engine wear and heavier oils is dealt with in our folder, "Lubrication—Its Relation to Engine Wear." Rather than invite additional repairs and trouble through the use of too heavy oil, it will pay you to write to our nearest Branch for a copy of this paper.

* * *

THE CORRECT OIL for your car—during its entire life—is specified by the Gargoyle Mobiloils Chart of Recommendations.

If your car is not listed in the partial Chart shown here, consult the complete Chart at your dealer's, or send for booklet, "Correct Lubrication," which lists the correct grades of Gargoyle Mobiloils for all automobiles, tractors and motorcycles.

GARGOYLE

Mobiloils

A grade for each type of motor

DOMESTIC BRANCHES:
New York *(Main Office)* Philadelphia Detroit Minneapolis Kansas City, Kan. Boston Pittsburgh Chicago Indianapolis Des Moines

Chart of Recommendations

(Abbreviated Edition)

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	1921		1920		1919		1918		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Acason (1 and 1½ ton)	A	Arc	A	Arc	A	Arc	A	Arc		
" (3 ton)					A	A	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	Arc	A	Arc
Acme (Cadillac, Mich.) (5 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Apperson (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							A	A	Arc	Arc
Armleder (1 ton)	A	A	A	A						
" All Other Models	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Atwater-Kent (Mod. 8-E)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Autocar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Bessemer	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Bethlehem (2½ ton)							A	Arc	A	Arc
" All Other Models	A	A	A	A	A	Arc	Arc	Arc	Arc	Arc
Biddle	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe (2½ ton)	A	Arc								
" (3 ton)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac	A	A	A	A	A	A	A	A	A	A
Chalmers	A	A	A	A	A	A	A	A	A	A
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet (4 cyl.)					A	A	A	A	A	A
" (Model 490)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc		
Cleveland	A	Arc	A	Arc						
Clydesdale (5 ton)	A	A	A	A						
" All Other Models	A	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Commerce	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cunningham	A	A	A	A	A	A	A	A	A	A
Detroit (Model U)									A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Dodge Brothers	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Essex	A	Arc	A	Arc	E	E	E	E	E	E
Ford	E	E	E	E	E	E	E	E	E	E
Four Wheel Drive	A	A	A	A	A	A	A	A	A	A
Franklin	A	A	A	A	A	A	A	A	A	A
Garford (2 ton)	A	A	A	A	A	Arc	A	Arc	A	Arc
" (3½, 5, 6 ton)	A	A	A	A	A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
G. M. C. Trucks	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Gramm-Bernstein (2½, 3½, 5 ton)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Grant (6 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (Conv.) (Model 12)					A	Arc				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Gray Dort					A	Arc	A	Arc	A	Arc
Haynes (8 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A	A	A
Holmes	A	B	A							
Hudson Super Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Interstate	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kissel Kar (12 cyl.)					A	Arc	A	Arc	A	Arc
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Knight (Models M and MT)	A	A	A	A	A	A				
" All Other Models	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc		
LaFayette (Indianapolis)	A	A	A	A						
Lange	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lexington (Continental Eng.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liberty	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Lincoln	A	A	A	A						
Locomobile	A	A	E	A	E	A	E	E	E	E
Marmon (3½ ton)	A	A	A	A	A	A	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mack	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Maxwell	A	A	A	A	A	A	A	A	A	A
Marwell	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	A
Mercer (Pleiades)	A	A	A	A	A	A				
Mitchell	A	A	A	A	A	A	A	Arc	A	Arc
Nash	Arc	Arc	Arc	Arc	A	Arc				
" (Model 671)					A	A				
" (Cont'l Quad)	A	A	A	A	A	A				
" (1 ton and 2 ton)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
National (6 cyl.)	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (12 cyl.)					A	A	A	A	A	A
Overland	A	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard	A	A	A	A	A	A	A	A	A	A
Peerless (8 cyl.)	A	A	A	A	A	A	A	A	A	A
" All Other Models							Arc	Arc	Arc	Arc
Pierce-Arrow	A	A	A	A	A	A	A	A	A	A
" (Limousine) (5 ton)	A	A	A	A	A	A	Arc	Arc	Arc	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	A	A	A
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Rock Falls	A	Arc	A	Arc	A	Arc				
R & V Knight	B	B	A	A						
Saxon	A	Arc	A	Arc	E	E	E	E	E	E
Schacht (1 ton)	A	A	A	A	A	A	A	A		
" All Other Models	A	A	A	A	A	A	A	A	A	Arc
Service (2½ ton)	A	Arc	A	Arc	A	Arc	A	Arc		
" (130, 150, 160, 170)									A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Stearns-Knight	A	A	A	A	A	A	A	A	A	A
Stephens	A	A	A	A	A	A	A	A	Arc	Arc
Sterling (Buffalo) (Cont.) (3½ tons)			A	A	A	A	A	A	Arc	Arc
" " (5 tons)			Arc	Arc	A	Arc	A	Arc	A	Arc
" " (Models 7½ & 10t.)	A	A	A	A						
" " All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc
Studebaker	A	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Templar	A	A	A	A	A	A	A	A		
Velie (Models 22, 23 & 24)	A	A	A	A	A	A				
" (Model 25)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Wayne (36 valve)					A	A	A	A	A	A
" (3 and 5 tons)	A	A	A	A	A	A	A	A		
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White Hickory	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Wichita (Model O)	A	A	A	A	A	Arc				
" (Model EK)	A	A	A	A						
" (Model S)	A	A	A	A						
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Willys-Knight	B	B	B	B	B	B	A	A	A	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

Prominent Makes of Engines

Beaver (Models J-1A-1B and JC)	A	A	A	A	A	A	A	A		
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Buda (Models ATU-BTUC-TTU-DTU-ETU-FTU-HU-KTU-JD-JTU-XU-XTU-YE-YTU)	A	A	A	A	A	A	A	A	A	A
Buda All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Continental (Model R2)	A	A	A	A	A	A	A	A	A	A
" (Model T)					A	Arc	A	Arc	A	Arc
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Falls	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
G. B. & S. (Model AA)	A	A	A	A	A	A				
" All Other Models	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Herschell-Spillman										
" (Models JU-L-V and VA)					A	A	A	A	A	A
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Huntley	A	A	A	A	A	A				
Lycoming	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Northway (Model 10R)									Arc	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A
Rochester (Duesenberg)										
Waukesha (Models CU-DU-ES & FU)	A	A	A	A	A	A				
" All Other Models	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Weidely	A	A	A	A	A	A	A	A	A	A
Wisconsin (Models Q & QU)	A	A	A	A	A	Arc	A	Arc	A	Arc
" All Other Models	A	A	A	A	A	A	A	A	A	A

VACUUM OIL COMPANY

SEVENTY-SEVENTH YEAR

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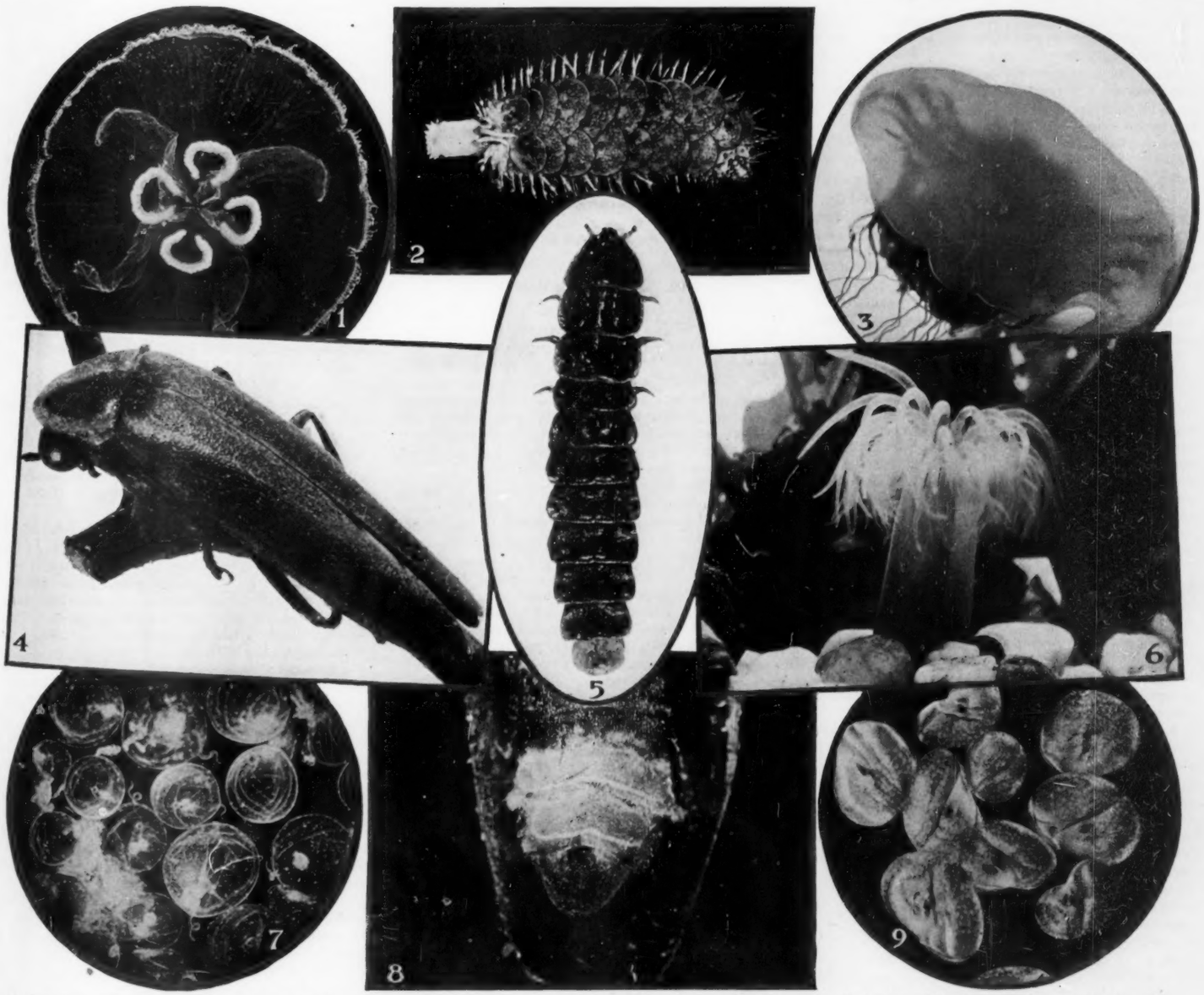

1. Aurelia, a jelly-fish. A phosphorescent animal. 2. Polynoe, a marine worm. This animal is covered with scales that glow with a brilliant blue light when the creature is disturbed. It is shown here with proboscis extended which it uses in seizing its prey. 3. Cyanea, a jelly-fish. A common cause of luminous flashes in the sea. 4. Photuris, the common firefly. 5. The glow-worm. This animal is not a worm but the larval form of the lampyrid beetle photinus, a common firefly. 6. Sagartia, the white sea-anemone. Erroneously believed to be phosphorescent. The luminosity of this animal is due to the ingested phosphorescent organisms which it captures with its flower-like tentacles. 7. Noctilucas, the microscopic animals which in large numbers cause the phosphorescence of the sea, greatly magnified. 8. The Lantern of the firefly. 9. Luminous scales of the sea-worm polynoe. These curious plates are thrown off by the animal on the slightest provocation. They are bathed in a luminous secretion which glows intensely when the animal is disturbed.

SOME OF THE LIVING LAMPS THAT SHINE BY NIGHT: VARIOUS FORMS OF LIGHT-PRODUCING SEA LIFE AND INSECT LIFE**—(See page 65)**

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Aviation Fatalities

IT WOULD be folly to shut our eyes to the fact that the success of commercial aviation is being delayed, if indeed it is not actually being jeopardized, by the frequency of fatal airplane accidents. It may be that the percentage of accidents in relation to the total mileage of flights is no greater than it was: but to the general public it must seem as though the number of people killed is disproportionately on the increase. The undermining of public confidence in the safety of flying is increased by the fact that so many of the recent fatalities have happened to highly experienced men, both in this country and abroad. The grievous accident when seven people were killed near Langley Field, the recent crash of a brand new army bomber, the death of such men as Alcock who flew the Atlantic and now of Hawker who made a gallant attempt to do so, have left an inevitable impression of the risks of flying, even when it is in the hands of the most competent pilots.

All these mishaps notwithstanding, there is not the slightest doubt that the art of aviation has come to stay. For naval and military purposes it is already invaluable—more than that it promises to absolutely control the strategy and tactics of the future both on land and sea. As between military and commercial flying, however, there is this broad difference, that in the one, enormous risks must be taken and death is one of the major chances of the game; whereas in commercial aviation, the public looks for, and has a right to expect, the same degree of security that attends commercial transportation on sea or land.

We do not hesitate to say that the future of commercial flying, at least so far as passenger travel is concerned, depends more than anything else upon the confidence of the public. When the would-be traveler is satisfied that he can use the swifter means of travel by way of the air, with a degree of security which at least approximates that of travel by steamship, train or automobile, the commercial future of aviation will be assured, and never till then.

A member of our staff who was in the flying service during the war and has a record of 1500 hours in the air, believes that a large proportion of airplane fatalities are unnecesary and therefore preventable. He holds as a fundamental condition of safety, that every pilot should have a sufficient degree of knowledge of the construction of an airplane, and of the stresses to which it is subject, to enable him personally to detect any oversight of inspection by the ground force. In theory the system of inspection by the ground crew is excellent; in practice there is danger of the inspection becoming perfunctory and therefore more or less careless. It is so in all lines of human activity; and in spite of the frightful results which may follow upon careless oversight, a ground crew is after all human—a fact which the pilot should never lose sight of, and against which he should guard, by developing his own mechanical competence and giving his machine a careful personal inspection before taking off.

Another suggested improvement is in the matter of periodic overhauling. Under the present system this takes place after a certain number of hours in the air. The method is too general; it should be made more specific; it should vary both with the plane and with the character of the service in which for the time being it is engaged. Ninety hours of one hour flights is not so severe on the machine as ninety hours of three hour flights. Frequency of inspection should vary, also, with the atmospheric flying conditions, and should be more frequent in stormy weather or when the flights are made over mountainous terrain.

As regards the human element, when once the machine is in the air for any but military service, there should be a stern prohibition of so called "stunt" flying, which confers no practical advantage upon the pilot and imposes stresses upon the machine that are unnecessary, that are too little understood, and that may and frequently do, result in a crash. Aerial gymnastics, if they had the sole effect of delighting the crowd and incidentally swelling the gate receipts, might be as unobjectionable as any other form of sport or entertainment that involves personal risks. Unfortunately, disastrous dare-devil flying ending in the death of the pilot, is a direct blow at the confidence of the public in commercial flying. Of this there can be no doubt whatsoever, and for this very practical reason we would like to see a combined movement of airplane associations and manufacturers to put a stop to this kind of public performance.

We have said nothing thus far about those two great fundamentals for safe commercial flying, namely—the provision of many and well found landing fields and the comprehensive radio dissemination of meterological warnings. With these two necessities provided, and with a well-thought-out system of Governmental laws and regulations, coupled with eternal vigilance in the matter of inspection, we should quickly reach the stage where travel by air would be as safe as travel by land or sea.

Sea Power in the Pacific

WE have before us a book, "Sea-Power in the Pacific," which has the double recommendation of being not only comprehensive, exact, and well written, but of making its appearance at a period of international affairs when just such a work as this is needed. The author, Hector C. Bywater, is one of those English lay critics who have done so much in past years for the British Navy, by keeping alive public interest and by stimulating Government action through intelligent constructive criticism.

The changed international conditions and the shifting of the center of gravity in naval affairs are well stated in the opening sentence of the book: "When the German High Sea Fleet surrendered for internment on the 21st of November, 1918, a brief but pregnant chapter in the history of sea power was brought to a close. The next chapter may be said to have opened in August, 1919, with the passage of the newly created United States Pacific Fleet through the Panama Canal, en route to its base in San Francisco Bay."

After showing in some detail the gravitation of sea power from West to East, a movement which began with the Chino- and Russo-Japanese wars, the author discusses the questions at issue between Japan and the United States. As a summary of the outstanding disputes, we know of nothing which compresses the whole story into a limited space so well as this chapter which, by the way, is written without prejudice and with marked fairness. The two chapters on the modern development and administration, and on the men and material of the United States Navy, form an admirable compendium. Nothing that is essential to the subject has been omitted, and many facts that will be new to American readers and that should be known to every well wisher of our Navy are herein set forth.

Then follow successive chapters on the inception, growth and purpose of Japanese sea power; on the administration, dock yards and shipbuilding resources of the Japanese navy; on men and ships of that navy; and finally a chapter on Japanese torpedo-craft, submarines and aircraft.

Unquestionably the most interesting part of this book is two succeeding chapters, one entitled "Strategy in the Pacific," and the other "Possible Features of a War in the Pacific." To the lay mind, the facts here brought out by Mr. Bywater, will be as unwelcome as they are sensational, although they have been well known to the officers of our Navy and have formed the subject of much study in our Naval War College for many years past. At the close of the Spanish-American War, when, in 1898 we took over the Philippines and Guam, the SCIENTIFIC AMERICAN pointed out the enormous naval significance of this action. We stated that, literally, we had given hostages to fortune and that, by the acquisition of these far-distant possessions, we had entered into the field of international politics and should be under the necessity of increasing our naval and military defenses accordingly.

Unfortunately we have failed to supply either the Philippines or Guam with modern fortifications and, as Mr. Bywater sees it, in the unhappy event of hostilities with Japan, we should stand to lose these possessions at the very outbreak of a war. Ultimately, as he points out, we should of course retake them; but because of our neglect and the lack of balance in the make-up of our Navy, even though the enemy would be ultimately crushed, the duration and the cost of the war would be greatly increased.

It is needless to say that this book was written before President Harding had sent out his call for an international conference on disarmament, in which the adjustment of the various problems of the Pacific will form one of the primary subjects of discussion.

A Better Merchant Marine Outlook

EVERYONE who has the interest of our merchant marine at heart should feel greatly encouraged to know it is now controlled by a man who has a well-proved record as an executive and who refuses to be daunted by the great problems confronting him. He has the confidence and good wishes of the American people at his back. The magnitude of his task is equalled only by the fine opportunity which it presents for doing a great constructive work for American shipping.

The Chairman has told us that he has a double object in view: First, to build up a large shipping business over the routes which have already been laid out by the Shipping Board, and over new trade routes which are yet to be determined upon. At the same time he will endeavor to strengthen the private owners, so that ultimately they will be in a position to buy outright the ships which are now owned by the Government.

As a result of the consultations between the Shipping Board and the operators and owners, the latter made several recommendations of men who are experts in the shipping business and allied lines of effort, and from these the Chairman has chosen three of the ablest, who will serve as vice-presidents under him in the Emergency Fleet Corporation, as it will be called. There will be two other vice-presidents, who will act respectively as chief counsel and as the active agent in the sale of the ships and the salvage of material—vast operations, when we remember that there are claims aggregating over half a billion dollars against the old Shipping Board, and that the ships to be sold cost nearly four billion dollars.

The Chairman tells us that the very first thing to be done is to straighten out the badly tangled affairs of the Shipping Board. So vast is this concern and so multiplied are the ramifications of its business, that the task will provide work for a large staff of lawyers for a long time to come. One definite step looking toward liquidation is to be taken at once—the whole of the fleet of wooden ships is to be placed on the market and sold at whatever it may bring. It is hoped that some of these will find their way into our coasting trade, and that what we do not take will be purchased for the coasting trade of other countries, notably of Norway and Sweden. Many of the ships, because of the haste with which they were built and the green timber that went into their hulls, are so far gone as to be useless even for the coasting trade. With their engines and boilers removed and their upper decks cut down they might be serviceable for barges. On the other hand, there must be many ships that were built in the best and most experienced yards, and that could be bought for a price so low as to justify a thorough overhaul and outfitting.

In forecasting the success of the new shipping regime we must remember that the evil days upon which foreign shipping has fallen will tend to soften the severity of the competition from that quarter. In the matter of regaining our once proud position as a maritime nation, it is now or never. "There is a tide in the affairs of men, . . ."

Aeronautics

Aerial Time Tables.—So important has become commercial aviation in France that there is being published a monthly time table of all the air services operating in France and allied countries. This time table known as *L'Indicateur Aerien*, gives such information as the time of departure and arrival, routes, type of plane employed, weight of luggage allowed, rates, and so on. The little publication appears on the first of every month.

The New Handley-Page Monoplane, which is at present under construction, has been designed specially for the Handley-Page slotted wing, and the slot will be capable of being opened and closed at will. Not much can be said regarding the machine at present, but we understand that the engine will probably be a 350-horsepower Rolls-Royce "Eagle" low-compression engine, and the speed is expected to be more than 100 miles per hour. The cabin is designed to seat ten to twelve passengers.

London-Paris Flights.—A new type of flying machine has recently been tried for the London-Paris service. It is a Vickers-Viking amphibian machine, which is a form of seaplane having adjustable wheels so that it can land on water and run on to the shore. By the use of this type of machine it becomes unnecessary to travel to the outskirts of London in order to take an airplane. The possibilities of landing at any time in case of mechanical trouble are much more favorable, as the Thames and the Seine offer landing facilities at almost any point.

Locating Oil by Airplane appears among the latest aerial novelties. In this case we have reference to a British oil concern that is using two flying boats to survey the delta of the Orinoco River in Venezuela. It appears that oil-bearing lands in this part of the world are distinguished by the partial destruction of the vegetation, and it is believed that an aerial photographic survey of the region will afford a rapid method of both locating oil fields and of discovering the most suitable forest paths and waterways for an approach to the fields. An opening is cut in the boat bottom to allow the camera lens a view, and this hole is fitted with a water-tight manhole cover secured by a kind of breech-block action. The camera can be raised or lowered into position.

Aerial Photography in Hydrography.—Attention is called to the importance of the paper submitted to the French Academy of Science by M. Volmat, in which he gives particulars of aerial photographic experiments carried out from a hydro-airplane, and emphasizes the importance of such a method in drawing up sea charts, so as to obtain quickly and exactly particulars relating to the lay of the coast, the conformity of shoals discovered at low water, etc. In the tests carried out 17 meters below zero on the chart was the greatest depth at which the bottom could be clearly seen. Great depths produce a characteristic surface movement of the waves. From the impression on a photographic plate of wave action it has been possible to discover a point of rock 8 meters below zero.

The Lust for Speed.— According to *L'Air*, France is still concerned with the problem of producing speed airplanes capable of defeating the existing world's speed records, the laws of resistance, and possibly the abilities of the best pilot to land on any airdrome smaller than the Gobi Desert. It is stated that in a certain number of new monoplanes, possessed of engines of anything up to 600 horsepower, thick wings, retractable undercarriages, and the absence of outside bracing, the constructors are hoping for a speed of 220 miles per hour, with a mere landing speed of anything over 125 miles per hour. The firms concerned are Nieuport, Spad, and Hanriot, and it is hoped that their efforts, at any rate to produce a really fast machine, will give rise to some remarkable constructions.

Deutsch de la Meurthe Cup.—Madame Henri Deutsch de la Meurthe and her family have decided to offer, in memory of M. Henri Deutsch de la Meurthe, a sum of 200,000 francs for an international speed contest to be called the Coupe Henri Deutsch de la Meurthe. The cup will be contested under the conditions laid down in the present regulations which have been drawn up at the request of the donors, and with their approval, by the Commission d'Aviation of the Aero Club of France. A sum of 200,000 francs will be distributed as follows: (*a*) An *objet d'art* of 20,000 francs. (*b*) Three prizes of 60,000 francs, each to be awarded to the winners of the cup, in accordance with the present regulations. The cup will be contested each year on a date and at a place set by the special regulations for the year.

Science

Memorial to Sir William Ramsay.—The Dean and Chapter of Westminster Abbey are to place a bronze medallion in the edifice for a memorial to Sir William Ramsay.

An Elevator for Bathers.—Atlantic City's newest hotel has a special elevator running to every floor for the convenience of bathers who can reach the beach by means of a tunnel under the board walk. They can come up dripping to their rooms without destroying the fine clothes of the neighboring guests.

Early Meteorite Records.—It is a curious fact that there were fourteen falls of stones or earth in Central Italy in forty years from 208-168 B.C. as noted by Prof. W. M. F. Petrie in a recent issue of *Nature*. It appears that the earth was then passing through a region of aerolites. The references in Livy are under the years A.U.C. 545, 548, 550, 558, 559, 561, 564, 567, 575, 579, 580, 583, 584 and 585.

Hunting for Quipe.—Professor W. W. Rowlee and George W. Mixter have sailed for South America for an exploration trip into Ecuador. Professor Rowlee, who is an authority on woods, goes in quest of quipe timber, great quantities of which he believes grow in Ecuador. Quipe is a very light, buoyant wood which is used extensively as a substitute for cork in the manufacture of live-preservers and similar articles.

Vacuum Cleaner Routs Bug Army.—When the commuter appeared in his front yard with the longest nozzle, meant for the picture moldings, attached to his vacuum cleaner, the neighbors were surprised, but his explanation was sound; he stated that he did not intend to vacuum clean the leaves, but there had been bugs on the trees for days, which were too slender and young to stand the weight of a ladder against the trunk and he did not have a spraying outfit. So he picked the bugs off the top branches with the vacuum cleaner.

Origin of the Guinea.—The mystery of that dreadful uncoined unit of barter in England known as the "guinea" which is abstracted from the pocket in place of the pound very much to the damage of the metric and all other systems seems to have been solved at last. Now the pound is 20 shillings and the guinea is 21 shillings so that it is cherished by hotels and lodging houses because it is divisible by seven. This is good as far as it goes, but why does a London doctor charge a guinea a visit when a quarter less (when exchange is normal) would do as well?

Beginning of Disaster on Mt. Everest.—Mount Everest has claimed her first victim, Dr. A. M. Kellas, a world-renowned explorer, dying of heart failure on June 5th. The expedition can hardly expect to escape with this one fatality. Colonel Bury states that the vegetation and colored butterflies are wonderful. The party received the full benefit of the monsoon. A couple of minutes of the huge deluge was sufficient to penetrate any waterproof coverings. The mules which were depended upon for transport home collapsed miserably and horses had to be substituted.

Have You Claustrophobia?—If you hate the subway you may not know you are ill but you probably are—of claustrophobia which is a psychological disease involving a fear of closed places. Of course the subway is only one of the places where this disease "discovered" by nerve specialists is manifested, the theater and the church are also predisposing causes. Other unnatural fears which are sometimes good grist to the aforesaid specialists are the fear of high places, fear of open spaces, fear of uncleanliness and fear of having forgotten something. Sometimes a person has all these and still survives to a ripe old age without the alienist or the asylum, so such fears through disagreeable environments are not very serious as they seldom unhinge the mind.

Steam Pressure Cookers in Ecuador.—A correspondent writes us that the Jivaru Indians have a steam "pressure cooker" all their own. A nearthenware jug or pot, small at the bottom, bellying out at the middle to about 15 inches, and then into a narrow neck, ends in a lipped mouth. A grid or false bottom of split bamboo is built about three inches from the bottom of the pot, the space between is filled with water; the food—meats or vegetables or both—is then placed on this grid and the top of the pot is covered with several large, palm leaves, criss-crossed and tied down with vines. The pot is then placed upon the fire and the food is thoroughly cooked in a very short time. This "latest" method has probably been used by the Jivaru Indians for centuries, and our correspondent says that he has enjoyed many a monkey and parrot cooked by this method.

Industrial Efficiency

Degumming of Ramie.—In a recent issue of the *Indian Textile Journal* the invention of a new process for degumming ramie fiber is reported. The process is past the experimental stage, as 1,000 pounds of ramie can be treated at one operation, producing from all qualities of grass a strong, durable and thoroughly degummed fiber, which has been satisfactorily dyed and spun. Ramie is reputed to be the strongest of all textile fibers and especially suited for all purposes demanding endurance of hard work, such as sail canvas, fishing lines and nets, boot laces, and shikari cloth. The ramie plant grows wild in most parts of India.

Oil-Bearing Nuts.—The royal palm tree, especially the varieties bearing corozo and cohune nuts, grows extensively in the coastal region of Guatemala, and although as yet little industrial use has been made of these oil-bearing nuts, they might become the source of an important vegetable oil industry, not only because of the great quantity of nuts in the country, but also because of the fact that the oil contents of the Guatemalan kernels is understood to be 65 per cent, in comparison with 42 per cent, for African nuts. The yield of kernels per ton of nuts in Guatemala is about 18 per cent.

The Graphite Industry.—In the island of Ceylon graphite is found in greater abundance than in any similar sized area in the world. The soil and rocks of Ceylon are almost everywhere impregnated with graphite, so that it may be seen covering the surface in the drains after a rain. The supply is practically inexhaustible. The peculiarity of Ceylon graphite is its remarkable purity. Another source of graphite is Chosen, the graphite found there being classified as scaly, fibrous, foliated and earthy, the first two classifications containing over 90 per cent carbon. In China, graphite is found in several localities.

Labor-Saving Machines for Philippine Hemp.—Many hemp-stripping machines of a simple type are in operation on the hemp plantations of Mindanao, and two 3-horsepower oil engines connected with sets of four stripping machines each have recently been installed in that region. The machines pull the hemp over a knife in much the same manner that it is cleaned by hand. They are comparatively inexpensive and are operated by one man. With the aid of one of these machines one worker can strip a picul (about 140 pounds) of fiber in a day, which would be a large amount of work for one week if done by hand.

More Heat from Locomotive Ashes.—Owing to the large amount of unburnt coal in locomotive ashes and smoke-box cinders, they have comparatively good calorific value, and, if collected, can be burnt in stationary boilers for the generation of electricity, according to *The Technical Review*. For the clearing of ashes out of the smoke-box, a vacuum pump is most useful; and for the clearing away of the ash and clinker which have been dumped in the ash pit, a bucket conveyor is used. This conveyor, in the case of a German installation, is driven by an electric motor, where the conservation of fuel is being practiced on an extensive scale.

French Steel Companies in Combine.—Through the office of our commercial attache at Paris it is learned that three of the largest steel corporations in France have recently combined. The principal company of the new combine is the Societe Anonyme des Forges et Acieries du Nord et de l'Est, the capital of which is to be increased from 46,000,000 francs to 86,000,000 francs, and to absorb the holdings of two other companies. It is stated that the new company will control an ore domain with equipment for an annual production of 4,000,000 tons, and also six large French coal companies and important coal deposits in England, as well as coke, cement, and building material companies, rolling mills, foundries and casting plants.

New Director of Bureau of Foreign and Domestic Commerce.—Julius Klein, who was appointed by the President as Director of the Bureau of Foreign and Domestic Commerce to fill the position made vacant some time ago by the resignation of R. S. MacElwee, has assumed his duties. Dr. Klein first came to the bureau in September, 1917, as chief of the Latin-American Division. He remained in that capacity until May, 1919, when he was made commercial attache to the Department at Buenos Aires, Argentina. He resigned from his position in October, 1920. Dr. Klein has specialized in Latin-American economics, trade, and politics, and since his resignation as commercial attache he has held the chair of assistant professor of Latin-American history and economics at Harvard University. He comes from this position to the Bureau.

Pulling the Mississippi's Teeth

What Is Being Done by Way of Making Our Longest River Navigable

By George H. Dacy

OUR Father of Waters, the peaceful, placid, tortuous Mississippi, which runs amuck and bursts its bounds only once in a dog's age, is unique as a channel of inland barter and commerce. Its shipping potentialities and prospects were long neglected during the period when rail traffic was in its 'teens. For this reason and that reason, because of disinterest of those who would be benefited most by its development or because Congress was always too busy with other affairs to bother much about the crooked, illy-navigable river, the Mississippi for scores of years pursued her catch-as-catch-can course, unharassed and unsung. River packets and freighters, scows and bumboats, dories and derelicts plied their difficult and hazardous ways between St. Louis and New Orleans. Year after year, the stationary volume of traffic and unchanging type of boat bore witness to our lack of appreciation of one of the best inland waterways with which any country ever was blessed. Participation in the international war changed the focus of the glass through which we had missed seeing the possibilities of the Mississippi River. The Mississippi at last came into her own and a belated development was instituted. Much has been done toward bettering shipping facilities and shipping conditions; prospects are that much more will be done in the future. The Father of Waters finally will occupy the prominent position in our interstate freight exchange which its natural advantages justify.

In January, 1918, the Director-General of the Railroads appointed a committee to study the possibilities of utilizing our inland, canal and coastwise waterways for transportation purposes. Six months later, an appropriation of approximately $8,000,000 was authorized by Uncle Sam for the construction of a federal fleet of barges to operate on the lower Mississippi. Twenty steel, flat-deck barges of the U. S. Engineers, capable of carrying 450 tons of freight apiece, as well as eight barges ranging in tonnage capacity from 400 to 1000 tons, were immediately chartered for freighting service. Simultaneously, plans were devised and work begun on the construction of a fleet of new, auxiliary barges. These activities have continued even after the cessation of warfare with the result that right now the Federal barge line which operates out of St. Louis has in service six old-type tow-boats, one new self-type propeller tow-boat (5 similar boats are under construction), 40 two-thousand-ton steel barges, and 4 smaller steel barges which range in size from 500 to 1000 tons.

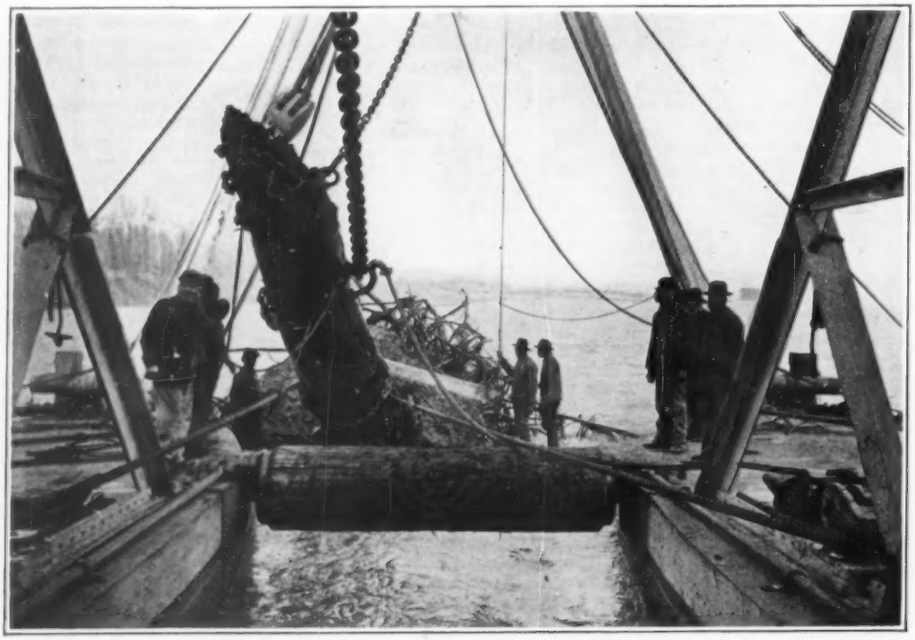
With the remarkable improvement in the shipping facilities along the lower Mississippi, the importance of maintaining the channel navigable and free of all obstructions has been intensified. This brings into the limelight the novel snag boats, the most extraordinary vessels which Uncle Sam supports—either in or outside of his Navy. The Mississippi carves out and carries away huge fragments of the banks that fringe her crooked course. Untold miles of these consist of farm timberlands and forests. As a result, she often dislodges and steals great strips of land containing large trees. These impediments she whips away only to have them sink and settle, ultimately, in the sand and mud of the open channel—there to effect evil and ruin unless discovered and eliminated by Uncle Sam's water sleuths. The general term "snag" may signify anything from a small tree of half a ton or so to an entanglement of large fellows weighing many tons. Whatever their size they must come out if they are in the channel.

Away back in the days of Mark Twain, Government snag boats were operated on the Mississippi, although the obstructions were not removed as scientifically and efficiently in that era as they are in the present. Rivermen and navigation experts say that this service will have to be continued as long as the river exists and is utilized for transportation purposes. The Government now maintains three large snag boats on the Mississippi, two on the lower river which police the beat that extends from St. Louis to New Orleans, and one on the upper river, north of St. Louis. One other large snag boat is operated on the Ohio River while smaller vessels patrol such tributaries as the Arkansas and Missouri.

For the last 33 years the Government has annually appropriated $100,000 for snag work on the lower Mississippi. Two snag boats, the "Horatio G. Wright" and the "John N. McComb" are specially designed and equipped for this service. The peak of their activities comes during the summer months from July on, when the river is low and the quest for snags is most fruitfully rewarded. The usual plan is to maintain one of these boats at the southern extremity of the Mississippi and the other in the northern districts adjacent to St. Louis, as bases. This means that the boats can speed to localities where snags are reported as dangerous in their respective zones without needless overlapping travel. In one trip of 1100 miles last summer, the "Horatio G. Wright" sighted, pulled and destroyed over 600 gigantic snags, the average weight being more than 40 tons while the heaviest topped 175 tons. The next trip over its beat, this police boat destroyed only 200 snags. River conditions, the water level, the season of year and various other factors influence the prevalence and appearance of snags, so that it is impossible to plan a definite and accurate campaign and to estimate the work and the number of snags which will be spotted and lifted in a certain season.

The maximum speed of the snag boats, each of which is about 190 feet long and 95 feet wide and carries a crew of 45 men, is approximately 8½ miles an hour in still water. Ordinarily, the snags point down-stream and often are buried anywhere from 10 to 40 feet deep in the mud, the tendency for trees which are carried away in the shore-undermining activities of the turbulent waters being to right themselves and to settle in the sand in an erect, upstanding position. The snags are so securely anchored that they rip holes in the bottoms of vessels which collide with them. Waterlogged, anchored snags effect the greatest damage; river pilots have had to contend with them ever since navigation between New Orleans and St. Louis was begun. The position of the snag in the water is indicated by the V-shaped break which it causes in the surface of the river. A snag submerged even as deep as 30 or 40 feet causes a boil in the overhead surface water which is easily recognizable by the lookouts on the snag boats. The Federal snag boats are of the double-bowed, catamaran type with a steel butting beam 15 feet long and 10 feet wide connecting the bows. When a snag is sighted, the boat is maneuvered close to the point where the V-shaped break appears on the water surface so that the crew can lower a huge sweep chain operated by means of 4 engine-driven capstans, each of which can exert a pull of 35 tons. The chain finally will engage the snag and raise its free end out of the water. Windlass chains are then used to haul the snag on to the beam, a special engine being used to run an enormous drum which releases or winds up a huge sansom chain that can resist a strain of 75 tons. The individual links in this chain weigh 27.5 pounds and are made out of round iron 2½ inches in diameter.

In case difficulty is experienced in loosening the snag, the boat resorts to butting tactics. It backs away from the obstruction about 60 feet and then under full steam slides at the snag and smashes into it with its steel butting beam and 800 tons of total weight. This method of attack is repeated until the snag gives way. The shock of the concussion is so violent that frequently all the members of the crew are sprawled headlong on the deck and the firedoors under the boilers are knocked open. When the snag is freed sufficiently, the windlass chains are used to haul it up over the beam where it is placed in such a fashion that engine-driven saws may be used to cut the tree or obstruction up into sections about 20 to 25 feet long. These logs are then cast overboard and generally are salvaged and sold by squatters who live along the river banks or by parties in gasoline launches who follow the snag boats and make a business of gathering the drift logs and hauling them to sawmills and selling them. Sometimes, these loggers of the river realize $100 or $150 from a single day's work in salvaging stray logs which emanate from the activities of the Government snag boats. Snags which will not float after being dismembered are hauled on the snag boats to deep sections of the river and there dumped overboard. They sink in the sand and henceforward do no more damage.



The heavy chain is used to haul the heavy snags over the roller. Each link of this chain weighs 27.5 pounds and is of 2½-inch round iron

Considerable danger is associated with the raising and destroying of the river snags, but despite the hazards, men like to work on the Government boats as there is a certain romance associated with this pioneering work which appeals to the adventurous natures of the rivermen. During the last score of years, four men have been killed and 60 injured on the snag boats as a result of slipping or breaking of chains or the sudden collapse of snags when they were pulled from their mud beds. In the case of wrecks which have sunk to the bottom and are dangerous to traffic, experienced divers are employed to salvage the valuable machinery and then the heavy drag chain is used to smash them into small timber. Sometimes accidents ensue here.

These unusual craft of Uncle Sam are also employed in raising wrecks which are still serviceable. A noteworthy accomplishment of this description was the lifting of the wrecked packet steamer "John Simonds," sunk during the Civil War and raised to the surface a half century later. The machinery in this boat was still in excellent condition despite its long sojourn in the water.

(*Continued on page 70*)

The Temple Driver—a Powder Gun Which Has No Recoil, Concussion or Flash

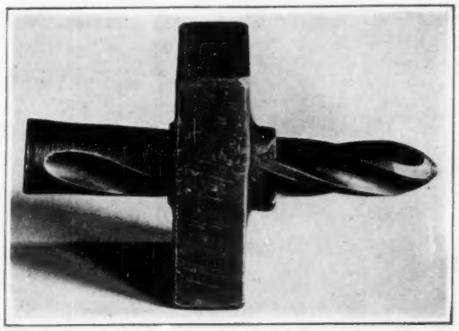
OCCASIONALLY a useful invention makes its appearance which is so entirely novel in its operation and practical applications that it is difficult to find a properly descriptive name. In this class is the subject of the present illustrations and story. It is a gun, for it derives its extraordinary power from the combustion of gun powder, but unlike the gun, it finds its immediate and largest field of usefulness in the constructive arts. It takes its name from Mr. Robert Temple, an engineer who received the decoration of "Order of the British Empire" for his inventions and service in the World War.

For the reason that this device is under consideration by the Naval and Military Authorities, its construction and the principles on which it operates cannot be disclosed at the present time, although we hope to give a fuller description at a later date. We have seen and handled the gun in its disassembled condition, and it is sufficient to state, just now, that it involves an entirely new principle in ballastics or, rather, we should say that it consists of a novel and very ingenious application of old and well understood principles. For the present we publish the accompanying photographs showing the tool and some of the work done by it in a demonstration by Dr. Miller Reese Hutchison, in this city.

The gun proper containing projectile, powder and firing mechanism

The Temple Driver is a small portable tool of about the size and half the weight of a pneumatic riveter. The driver, or gun (for such it is), is shown held in a person's hand. It is about an inch and a half in diameter and ten inches in length. In the demonstration we witnessed, it shot a projectile of case-hardened machine-steel into a piece of boiler plate five-eighths of an inch in thickness. This was one of a large number of bullets which had already been shot into the same plate, and the powder charge and the various internal elements of the gun had been so adjusted, that all the bullets came to rest with their center of length lying in the center of the plate and equal portions projecting on either side. The after half of the bullet is threaded so as to enable a nut or a threaded eyebolt, suitable for attaching a lifting hook, to be screwed home after the bullet has penetrated.

The novelty of the gun consists of course in its short length and small weight in proportion to the power developed and also in the fact that there is no recoil, no escape of gases, no report, and no flash. The means by which these last three results are obtained cannot at present be disclosed and it must suffice to say that they are simple, practical and based upon the laws of the expansion of gases and of inertia. In firing the gun in the case of the test referred to and herein illustrated, the muzzle is placed against the plate at the point to be perforated, and a pressure upon the handle of the sleeve in which the gun slides serves to detonate the powder charge.

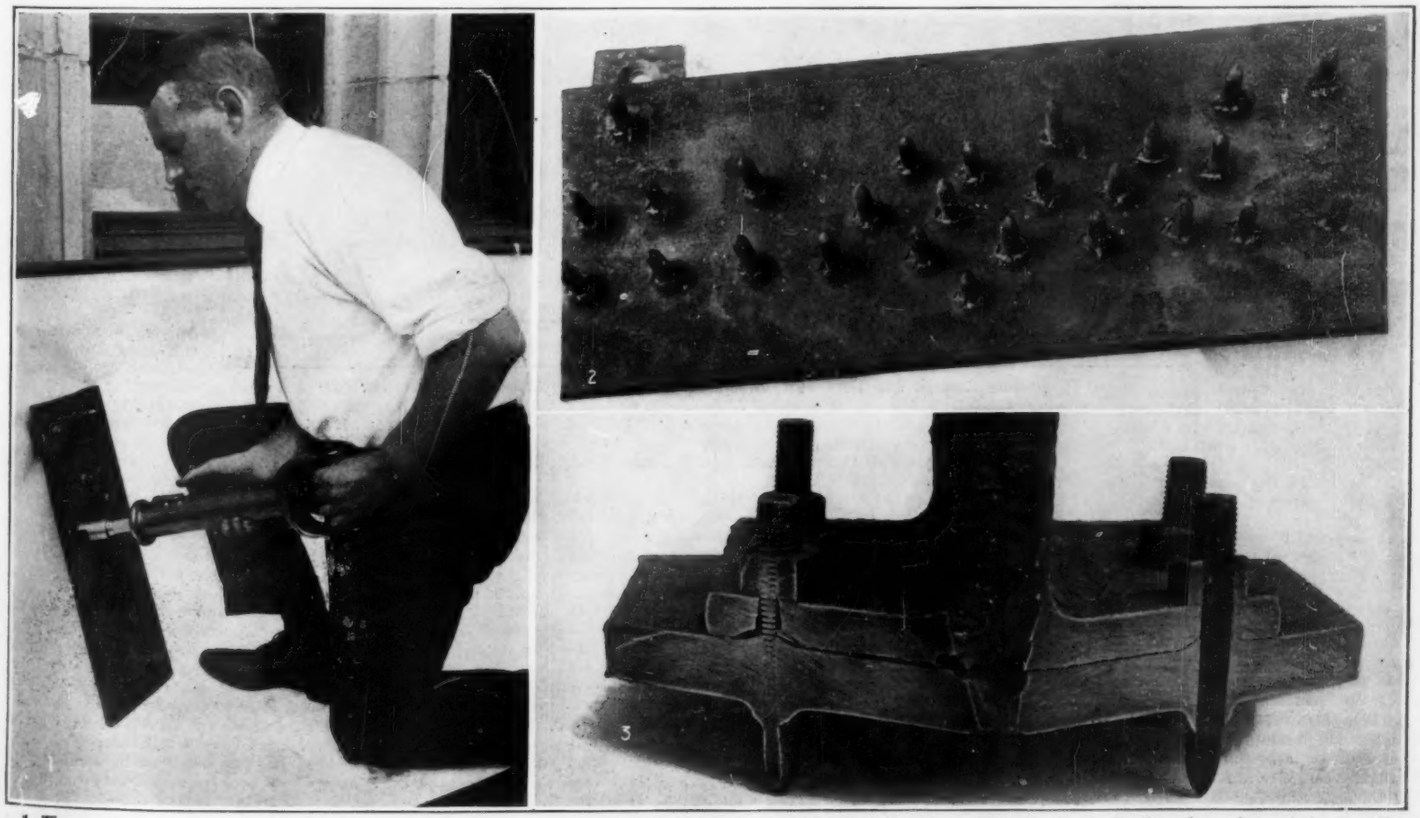


Projectile in form of twist drill cut a spiral path through steel plate

A big field of usefulness for this machine lies in deep sea and salvage work. Thus, the well-known deep sea diver, Crilley, shot a one-half inch steel stud into a five-eighths inch boiler plate at a depth of 36 feet below the East River, New York. The plate was then put under a testing machine in the laboratory of the New York Navy Yard by Navy officials who wished to determine the pressure required to force the bolt out, and it was found that a pressure in excess of seven tons applied at the pointed end of the stud was necessary.

Another significant test was made by the Merritt Chapman Derrick and Erecting Company's diver who, under water, attached a lifting plate to a heavy dredge bucket by shooting four studs through the lifting plate and the bucket. On hoisting, the bucket was lifted by these studs. Then, in order to subject them to a heavier strain, the bucket was allowed to fall a certain distance, when its movement was arrested suddenly by checking the lifting gear. The attachment held fast.

The application of this contrivance in the arts and industries may be various, but obviously it will have immediate use for the lifting of sunken ships and for the placing of patches over perforations in the hulls of disabled vessels. The patch plate would be drilled with the number of holes desired, and the inner face of the holes would be countersunk to allow space for the metal of the plate that is to be perforated to flow back in the direction from which the stud or bullet enters, for there is an extrusion of metal on both sides of the plate around the stud. When the patch plate has been adjusted in place, the diver fires a stud through each hole in the patch, thereby riveting, or clinching it in place. It is evident that the lifting power will be limited only to the number of studs employed.



1. The gun is mounted and handled like a pneumatic riveter. 2. Back of boiler plate into which 26 bullets have been fired. 3. Section through angle-irons and bullet studs, used to lift a sunken boiler

Molybdenum Steel in the Motor Car

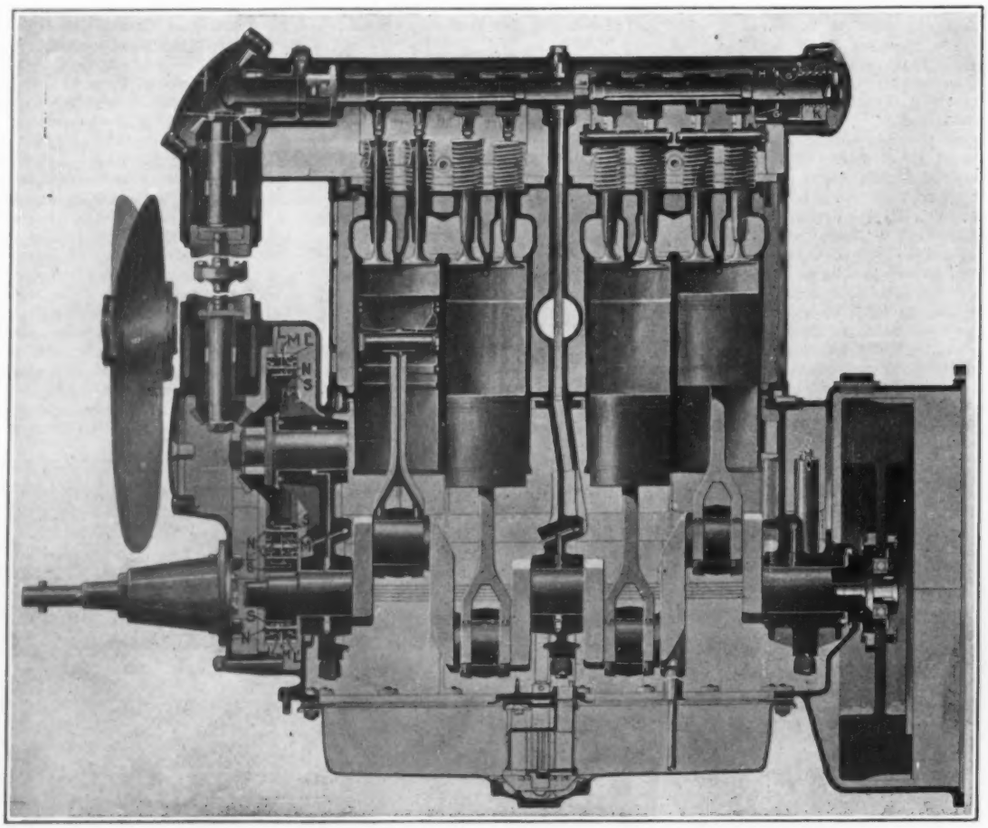
Reducing Weight in High-Power Cars by the Use of New Steel Alloys

BROADLY speaking, it may be said that the effort of the designer of the modern motor car is directed mainly to two objects, an increase of the power and a decrease of the weight; for it is certain that in spite of all that has been said about the smooth riding of heavy cars, no one wishes to carry unnecessary dead-weight around with him, and everyone wishes to have a reserve of power in hand upon which he can call in emergencies. Increase in power has been gained by careful design, in which improvement has been carried into the smallest details, and also, and more particularly, by a great increase in the speed of revolution. On the other hand, decrease in the weight of a car has been secured by a great refinement in the parts, following upon a careful analysis of the stresses to which each member of the car is subjected, and also, and more particularly, by the use of the wonderful alloy steels which developments in the metallurgy of steel have placed at the disposal of the automobile builder.

What metallurgy has done for the automobile in recent years would make an interesting story in itself. From the ordinary commercial steels of which the early motor cars were built, we have progressed through the special carbon steels and the various alloys, up through the vanadium steels to the latest and most remarkable of them all, molybdenum steel — a material of construction which was practically unknown in this country prior to the war, and only now is coming into its own.

The use of molybdenum steel in motors in this country is to be credited chiefly to Mr. C. Harold Wills, who for about twenty years was associated with the Ford factories, and more than anyone else was responsible for that remarkable combination of light weight, power and durability which is to be found in the Ford car. To him also is to be credited the special machinery and equipment and the quantity - production methods, which brought the output of the Ford factories up to a total of over 3,000 cars a day.

The commercial introduction of molybdenum steel in the United States was brought about by the demand, for use in the Liberty motor, of a steel of super-excellence; and, in response, Mr. Wills turned his attention to the new alloy, molybdenum steel, which he used successfully for the crank shafts. The service secured from these crank shafts and from other parts of the motor for which molybdenum steel was used was eminently satisfactory—so much so that Mr. Wills decided to devote himself to the development of an automobile, of light weight and high power in which this material should be used for all those parts of the machine that are subjected to great stress. To this end he built the new plant and town of Marysville which formed the subject of our article in the issue of the SCIENTIFIC AMERICAN of March, 12, 1921.



Section through one block of cylinders of the new molybdenum-steel motor car

Advantages of Molybdenum Steel

There is probably no mechanism in the world today that is subjected to such hard usage as the working parts of an automobile. Not only are the stresses dynamic, but they are subject to reversal; and because of the insistent demand that the weight shall be kept down, it is necessary to reduce the size of the parts to a point where the stresses, at times, must necessarily approach the limits of elastic strength. The steel employed must have the combined qualities of hardness, toughness, resiliency, and ability to withstand sudden and great reversals of stress and a continued succession of shocks of the heaviest character. The merit of molybdenum for automobile construction lies in the fact that it meets all these heavy demands with such reliability and staying power that it is possible to reduce the sectional weight of the parts to a point which no manufacturer would care to approach with any other known steel. This will be understood when we state that, whereas it would have to be a very good carbon steel that a manufacturer would care to submit to a unit stress of 70,000 pounds to the square inch, the new carbon-molybdenum-nickel steel can carry a unit stress of 150,000 pounds with safety. Moreover, the molybdenum steel would be the tougher of the two. Naturally, there are variations from the above-quoted figure; for in parts of the car that are subjected to great fatigue, such as the connecting rods, the unit stress drops to 135,000 pounds to the square inch. On the other hand, in the gears it is possible to use a unit tensile stress running as high as 335,000 pounds.

The advantages of using a small percentage, from 0 per cent to slightly over one per cent, of molybdenum in steel, are stated by Mr. Wills as follows: First, in forge practice, the molybdenum has no tendency to segregate, and rather tends to prevent segregation of the other ingredients of the molten steel; second, the range of temperature for heat treatment is greatly increased, and instead of being confined within ten to twenty degrees Fahrenheit, as is usual in present commercial alloy steels, the range is increased to about 200 degrees. To put it another way, molybdenum prevents detrimental structural and chemical changes from taking place until the temperature rises several hundred degrees above the point of recalescence. Consequently, elaborate furnace-regulating equipment is eliminated and losses in manufacture and in service are reduced to a minimum. Moreover the use of molybdenum makes it possible to draw at a much higher temperature than could be used in other alloys. Another great advantage is the excellent machining characteristics of the steel, which may be machined to finished size without suffering any distortion. As to its physical properties, the tensile strength and the elastic limit are greatly increased, and a maximum elongation is obtained. The steel has a very high resistance to impact shock and to alternating stresses, which it will withstand without crystallization. Another advantage is that, due to the excellent action of the steel under case-hardening processes, it is possible to secure a material with a tough center and a hard wearing surface, such as is required in gears, cams, camshafts, roller bearings, valve pins and other automobile parts. In case hardening, Mr. Wills finds that molybdenum secures a deeper penetration with a heavy carbon content at the surface.

Reduction in Weight

It will be understood that in designing the working parts of a car upon the basis of a unit stress of from 150,000 to over 300,000 pounds to the square inch, it has become possible to make a very considerable reduction of weight in proportion to the horsepower developed, and although the Wills type of motor car has developed a brake horsepower of 65 to 70, the weight of the car runs from 3,000 to 3,200 pounds, according to the equipment. In the load test the car developed from 65 to 70 horsepower at 2,700 revolutions per minute.

The Engine

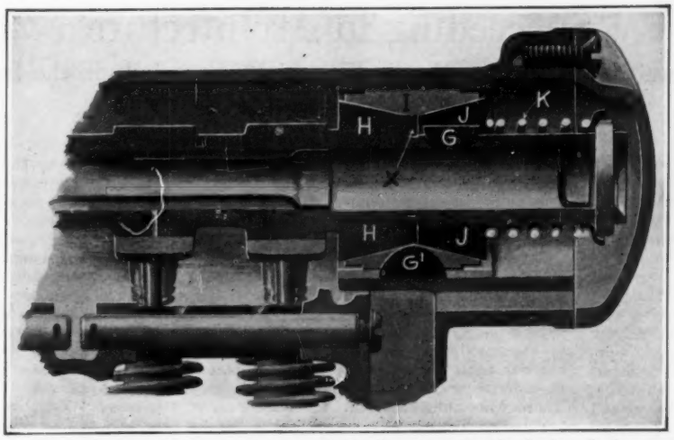
The engine, which is of the 8-cylinder V-type, embodies features both of automobile and airplane engine practice. The cylinders are set at a 60-degree angle with overhead valves and camshafts, and gear drive, the carburetor being carried above and between the cylinders. The stroke is 4 inches, and the bore 3¼ inches, giving a total displacement of 265 cubic inches, or 3.8 cubic inches per horsepower based on a maximum output of 70 horsepower. This is a remarkable showing, being exceeded only by certain of the racing cars of which the most notable case is the Begatte, with 2.5 cubic inches per horsepower. Compared with commercial cars, we find that one of the best known of the high power cars has 5.5 cubic inches per horsepower, another 6 cubic inches. In the Ford is reached the high figure of 8 cubic inches per horsepower.

The valves are seated in the cylinder head. The intake valves are made of chrome molybdenum, and the exhaust valves and valve stems, T, are built up of various metals, with a view to eliminating changes of length, due to expansion and contraction, and securing good wearing quality. The stem, T, is of 39 per cent nickel and steel, an alloy which shows a minimum contraction and expansion under variations of temperature. The face, V, of the valve where it seats against the cylinder is of 40 per cent chrome steel, and in the head of the valve stem there is welded a button of the same hard, 14 per cent chrome steel. The cylinders are of special cast iron, cast in blocks of four, and the pistons are of a close-grained cast iron, with a flat top, polished to prevent carbon deposit. The camshafts connecting rods, front axle, transmission gears

and shafts, springs and wheels are all of molybdenum steel.

Eliminating Noise

Particular attention has been paid to the elimination of noise in the running parts of the car—a prime consideration at all times—and in securing this result some very ingenious work has been done. Take, for instance, the camshaft. As we all know, the cams are so distributed circumferentially upon the shaft that the latter is subjected to intermittent stresses as each cam comes into operation. At the lower speeds, this has a vibratory effect upon the shaft, with the result that a singing note or humming sound is given out by the metal, which disappears only when the revolutions have reached a point at which the applications of stress to the camshaft occur at such high frequency that they have the effect of a continuous torque. When this point is reached the objectionable hum disappears.



Detailed view of after end of camshaft, showing noise-deadening devices

To counteract this, it was determined to apply a continuous braking force upon the camshaft, which should continue until the critical speed was reached at which the hum of the shafts disappears. Accordingly, the rear end of the camshaft was extended and provided with a fixed cone, H, a sliding cone, J, and an annular double cone, I, designed to engage Hand J. Normally, the faces of the three cones are maintained in contact by the action of a coiled spring, K, mounted upon the shaft and secured thereto. It should be explained that the ring or double cone, I, is so keyed to the casing as to allow of longitudinal movement.

In operation, the pressure of the spring, K, keeps the cones and the ring in such frictional contact as to produce a braking effect upon the camshaft. But as the speed increases, the centrifugal effect forces the lubricating oil to work its way out from the space, X, and between the faces of the cones and the ring, I, until the ring is running on a film of oil and the frictional retardation of the shaft is eliminated. The coil spring is adjusted so that this release will take place as soon as the critical speed has been passed. This ingenious device has proved to be very efficient.

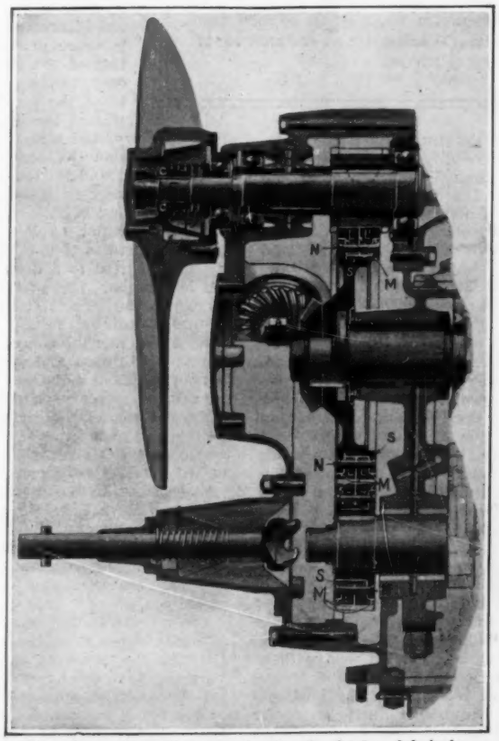
Another part of the machine from which noise has been successfully eliminated is the gears. The gear wheels have their own metallic note, and the problem was to find some means of damping out the vibrations which result from the successive contacts of the teeth. This has been done in the Wills motor car by forming the periphery of the gears in which the teeth are cut, in three parts and reassembling them with sheets of paper, M, or other noise-deadening fabric, interposed between the parts. The teeth are formed of two rings, L and L', L-shaped in section, which are placed back to back and held in the periphery of the wheels by means of a clamping ring, S, and a series of rivets, N, the strips of paper fabric being inserted in the three places indicated in our drawing.

Some Other Details

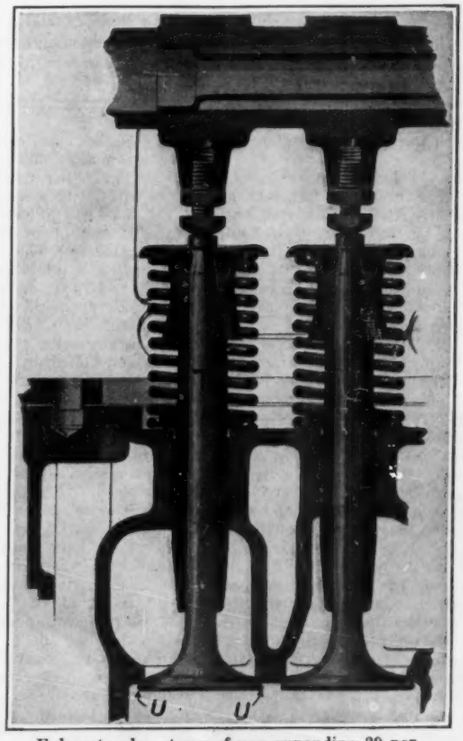
Among other details which are shown in our drawings is the clutch release for the fan. The fan reaches its highest effect at a certain speed of revolution, above which it simply consumes the horsepower of the engine, with no useful return. Hence, a clutch release of the cone type is used. The fan A is drawn into frictional contact with the cone C on the shaft E by the action of a coil spring F. When the speed of the fan A reaches the point of highest efficiency, the reaction of the air against the blades becomes stronger than the tension of the spring F, and release takes place. This point of higher efficiency is shown by laboratory tests to be reached at a speed of 2700 revolutions per minute. At higher speeds the fan causes a useless consumption of horsepower.

We direct attention also to the clutch, which is of the multiple dry-disk, central-spring type, with six driving and six driven disks. In order to secure application of the clutch with a cushioning effect and a gradual take-hold, without shocks or jerking effects on the car, use is made of a lining of asbestos cord, which is woven into the driving disk in the manner shown in our drawings. This lining cannot be burned and has an unusually long life.

The lubrication is of the forced-feed type with a pressure regulating device, the crank, cam, and camshafts being drilled axially to provide lubricating channels. Particular attention has been paid to the crank pins, where the oil passages are drilled tangentially to the axial hole, and the oil is forced by centrifugal action into cup-shaped channel ways, formed at the periphery of the crank pin to assist in the free distribution of the oil. Finally, it should be noted that molybdenum steel has been used in the wheels, which are of the disk type and designed specially for this car. Here, also, there is a gain in strength, with a marked saving in weight.



This shows fan release and noise-deadening fabric in the gears



Exhaust valve stems of non-expanding 39 per cent nickel steel

Learning Things About Cider

WE never knew so many things about apple cider as we are suddenly learning in this new prohibition age. Cider is an old-fashioned farm beverage. It was typically made, in the old days, in water-power mills. The cider-mill was a local mill to which farmers hauled cider apples—often culls and natural fruit—in dump-carts. The cider barrel was a hogshead with a great wooden bung, around which a piece of burlap was often wrapped. Farmers used to say that Russet cider—meaning cider from Russet apples—was the best there was.

But what old-timers knew about apple cider was as nothing to the kind of knowledge which the nation is now rapidly acquiring. The consumer in large cities is learning that apple juice is a wonderful beverage, and demanding it, and overnight a manufacturing industry of large proportions has developed. The seat of twentieth century cider-making is not, as it was twenty-five years ago, the country water-power mill. It is a city industrial plant, to which apples for cider are often shipped long distances.

This city plant makes cider from time to time through the winter, drawing on stored apples and supplying dealers with a constant fresh supply. In the old-time cider mill, cider was usually only made for a short period in the fall. Sweet cider in the country never has been obtainable for much more than a few weeks after apple harvest. Then the cider has grown hard; it's on its way to vinegar. So there is much feverish experimenting with processes to keep cider sweet. The value of such processes, in this prohibition age when new beverage habits are being formed, is obvious.

A few years ago cider apples were always obtainable for a few cents a bushel. But when, in early winter this year, producers on whose hands apples had become accidentally frozen, turned them into cider, the value of the liquid obtained from a barrel of apples was, in some instances, $7.

As only would be expected, matters connected with apple cider are "getting into court." In British Columbia, adjoining the State of Washington and equally dry, a cooperative farmers concern was accused by the provincial government of supplying a dealer with cider containing 10 per cent alcohol. Producing evidence that as shipped the particular consignment contained about 2 per cent, and suggesting that afterward somebody had put "something" into the cider, the growers called as an expert witness the manager of a vinegar factory.

This expert testified that it was chemically impossible for the cider to have developed the alcoholic content stated, without tampering. He said that the sugar content of Okanagan Valley apples, varying with the season and the particular variety of apple, ran from 7 to 14 per cent. The alcoholic properties of cider, he explained, depended entirely on the sugar content, the heaviest alcoholic proportion possible being 50 per cent of the sugar. The maximum development of alcohol in pure cider of Okanagan apples was therefore 7 per cent, so the growers were found innocent.

Cider is a coming beverage. Hand or power mills for making it at home are being extensively bought. There is a disposition in some quarters to discard the old-fashioned name, cider, and adopt another. The name cider is shrouded in a definite, peculiar atmosphere all its own—an atmosphere which some fastidious ones are not taken with.

Succeeding in Architecture

Opportunities Awaiting the Young Man in This Field, Especially in the Immediate Future

By Raymond Francis Yates

THE author spent several very pleasant hours with Mr. William Crocker, Editor of the *American Architect*, in gathering material for this article. Mr. Crocker is an energetic man, brimming over with enthusiasm and love for the field he is working in. In giving the advice contained in the following lines, he spoke as if he were giving counsel to his own son, and the writer heartily wishes that every young man who plans to study architecture could spend a few precious minutes with him. The warmness, sincerity and honest truth of his words are inspiring.

Many people are inclined to look upon an architect as a man with great artistic ability—in fact, an artist. He should wear a Windsor tie, a VanDyke beard and his hair must be long and not too carefully combed. He should be very temperamental, work in a studio, not an office, and all the prerogatives of the Greenwich Village "artist" should be his. Certain men who stand high in the architectural field believe this and preach it. Mr. Crocker has an honest argument for those who are "responsible for that type of man who regards the æsthetics of his profession of more importance than its practical aspects." He rightfully asks: "Have we developed designers to a greater extent than architects?"

An architect is by no means a mere designer of buildings. Our college courses in the past have tended to make him such. When the United States entered the war, the architects were not only amazed but chagrined when they were put under the direction of engineers. It was the natural outcome of the course they followed. Many of them were 90 per cent designers and 10 per cent engineers, when they should have been 10 per cent designers and 90 per cent engineers.

A real architect must not only be a designer of buildings but also a practical engineer entirely capable of carrying out and overseeing the construction of the buildings he designs whether they be factories, libraries or homes. Since the war the colleges of this country have at last come to realize this fact and rapid changes are being made in the curriculum of architecture. These changes should have been made years ago but it took the World War to bring about this realization.

The architects who took part in the war were really put where they belonged—under the direction of practical engineers. Many of them were not capable of overseeing any real engineering work with any degree of success. An architect should be a building engineer capable of directing constructional engineers and other engineers who take part in the erection of buildings.

The field of architecture is by no means overcrowded nor does it offer large incomes to other than the real leaders in the field. Statistics show that but 4 per cent of the architects of this country paid an income tax last year. This is an amazing statement, but nevertheless true. Probably the 4 per cent who did pay an income tax paid it on rather large incomes. There does not seem to be any definite limit of salary for those who have struggled to the upper heights of the profession. Men like Cass Gilbert, who designed the Woolworth Building, enjoy incomes obtained by few men in this country. The field really does recognize men with ability, and offers tremendous opportunities to those who step out from the crowd.

A great number of architects go into business for themselves. Some start in small towns, others start in large towns. In any event they must be active in civic life as a matter of pure business. The architect in the small town should be active socially and take part in all civic programs—he must work himself into the life of the community. His first few years of business will be a hard struggle to establish himself. If he is fortunate enough, or has business foresight enough, to locate in a thriving community he will progress rapidly. Growing communities can increase in size no faster than the architect can design buildings and oversee their construction. If a young man, after leaving college, is unfortunate enough to pick a bad location real success will probably never smile upon him if he remains in business for himself.

Most of the colleges in this country have courses in architecture. A full four-year course is required to produce a thoroughly trained man. Men have been known to struggle along outside of college and train themselves in the fundamentals of this work. College is, of course, never necessary to the man with the real burning desire to succeed in any field.

After leaving college a young man cannot expect to derive a large income from the practice of his profession as an architect. If he locates with a company, a salary of $2,000 a year to start with would be considered good. If he goes into business for himself he may make $1,000 or he may make $5,000. This depends entirely upon his ability as a business man and upon the development of the community in which he locates. Those who make $5,000 in their first year of business are indeed fortunate.

There is nothing uncertain about the future of architectural science. It is one of those professions that will survive as long as civilization lasts. Building is one of the primary human occupations. There will be changes in the architectural field no doubt, but they will not affect it greatly. The greatest change that the field has had for many years is taking place at the present time. This change is by no means harmful. It is just the reverse. It will tend to make a more useful and capable individual out of the man who decides upon casting his lot in this work.

To be a good architect a man must first be sure that this is the field in which he should be working. Aside from this he should have good sound business training; he should be practical as well as artistic. He should be a "good mixer." To be this he must have a friendly disposition.

An architect must be able to handle and direct men. This is really one of the most important parts of his work and the architect of the future is going to be called upon more and more to direct a large corps of engineers working under him. The architect of the future will not be a mere designer of buildings; he will be the master builder. He must be a man of force, character and ideas. He must take his stand with other engineers. The day of the artistic prude who believes that it is his lot to design gilded cages for the wealthy to live in, or beautiful churches that will suit his artistic temperament, is gone.

An architect worthy of the name, like a man engaged in any other profession, should have some particular ambition in life. For instance, the writer once knew a young architect who had an ambition to design the most perfect tenement house ever conceived. It was his idea to perfect the design of a house that would be convenient, light, airy, sanitary and fire-proof. This was a very humanitarian idea and if this young man ever succeeds he will have done a great service to the world. The author also knew another young architect who believed that he could render great service by setting about to develop still better hospitals than exist today. He made a special study of the problem and it was his desire to gain recognition in this particular branch of architecture. There are a thousand and one ambitions that an architect could have and they would all tend to urge him on to a higher position in his profession. The young man who enters any engineering or technical field without an ambition to do something special in that field will wander aimlessly on never realizing anything of special note. It is the man with something to strive for who pokes his head above the crowd and makes a name for himself.

The United States is three years behind in its building program. During the war only that building which was necessary was carried out. Today hundreds of thousands of people are without permanent homes. It will take at least three years of energetic building to catch up. The high prices of building materials have not been reduced despite the fact that the war has been over for some time. With the gradual return of normal prices, the building of homes in this country will go forward with great haste and architects will be kept busy for several years designing homes and apartment buildings. In New York City alone one hundred thousand families are without apartments to live in.

ARCHITECTURE as a profession is generally misunderstood by the laity. It seems, so we are told by Mr. Yates in the accompanying article of his series on the opportunities in various lines of endeavor, that most people have come to look upon the architect as a man with great artistic ability, little engineering training, and still less business ability. The architect, in the popular mind, is often looked upon as a Bohemian, with all that designation entails. Fortunately, however, Mr. Yates has uncovered facts that prove the architect to be quite the antithesis of the proverbial artist; the architect, as he reveals him to us, is an engineer with a fine sense of art, a leader of men who can plan and direct big undertakings, and a business man and man about town, if he would be successful.—THE EDITOR.

The Remarkable Conduct of a Drop of Mercury

THAT lower organisms, such as amoebae, infusoria, bacteria and others that are capable of independent movement, are attracted by certain chemical substances has been known a passably long time already. For instance, fill a capillary tube with a weak solution of chlorate of potash or of peptone and put into it a drop of mercury in which bacteria are moving; after a few seconds these will be seen hastening to the mouth of the tube where they will all have assembled. The amoebae and the naked little masses of jelly (plasmodia) of the myxomycetes (mucous fungi) creep in their peculiar way by stretching forth their arms or feelers toward the stimulant. This faculty of such organisms, of accepting the attraction of certain substances, is called chemotaxis. Chemotactic susceptibility is evidently an advantage for these creatures as it leads them to good nourishment and keeps them near it.

Very recently an eminent physiologist made the discovery that a drop of mercury can make very similar movements. The starting point of his investigation was afforded by the experiment made by Paaizov in 1858. The latter put a drop of mercury in a little flat vessel; over this drop he poured sulfuric acid and then laid a small crystal of bichromate of potash immediately beside the mercury. The result was a periodical change in the shape of the drop of mercury which alternately approached the crystal, while flattening itself in front, and receded from it. This occurrence was provoked by the fact that the bichromate of potash, aided by the presence of the acid, oxidized that portion of the surface of the drop of mercury turned toward it and thus diminished the tension of the surface of that side of the drop. As soon as the peroxide of mercury, which had been produced, dissolved in the sulfuric acid the surface of the mercury became metallic again and its tension increased. In the first instance the mercury flowed toward the crystal, in the second it sprang back.

The physiologist, explaining his application of this experiment, states that through appropriate manipulation he imparted to a drop of mercury the faculty of real locomotion. One of the most successful forms of his experiment was this: he put a drop of mercury in a suitable dish, of glass, of which the bottom was perfectly level; then he poured in a sufficient quantity of diluted nitric acid and laid a little piece of bichromate of potash at a distance of several centimeters from the drop of mercury on the bottom of the dish. The yellow solution of the crystal began to spread itself in a circle and as soon as it reached the drop of mercury the latter with a curt tremor began to recede and then dashed straight to the crystal which it reached in a few seconds. In the liveliest manner it repeated this twitching movement. If, in consequence, the crystal moved away in any direction the drop pursued it, receded and approached, again and again, with a movement of mingled leap and glide, while stretching forth the long tentacles and quickly drawing them back again.

These remarkable phenomena may be considered as adequate support of the view held by the botanist, Bathold, the physicist, Quinke, and the physiologist, Verworn, that the amoeboidal and related movements are the result of changes in the tension of the surface of the living substance. Obviously, though, there are still other conditions which can vary largely the movements of the living prototype.

What Makes the Glow-Worm Glow?

What Recent Investigations Reveal in the Matter of the Luminous Organs of Various Insects and Sea Life

By William Crowder

THE nature of phosphorescence in light-producing animals has been a phenomenon which has engaged the attentions of investigators from a time far antedating the history of modern science. It was only recently, however, that the attempt to fathom the mystery was met with any appreciable degree of success.

Contrary to the popular opinion, the peculiar property of emitting phosphorescent light is by no means a rare one or confined to a narrow range of individuals. In the animal kingdom, in groups ranging from the protozoa to the vertebrates, there are more than three hundred genera which contain one or more species that are known to be phosphorescent. By far the great majority are those forms which live in the sea. Of these, perhaps the best known are Noctiluca, a microscopic animal which causes the phosphorescent light in the wake of a vessel; jelly-fishes, which produce flashes of light when colliding with a boat or struck with an oar; marine worms and small crustaceans.

As may be suspected, from their higher development, the fishes which inhabit the deep sea contain types which have the luminous organs specialized in a manner well-nigh perfect in their arrangement. The complexity of these organs may be understood when it is stated that in some individuals they function somewhat after the fashion of an eyeball; that is, they can be rotated to direct the light or turned completely to shut the rays off. In others there is an apparatus similar to an eyelid which acts as a curtain by which the light can be shut off or turned on at will. It is significant that those fishes distinguished by these extraordinary organs spend their entire lives at great depths far below the point penetrated by the light of day.

Of the land forms perhaps the most familiar phases of luminescence are to be found in the fireflies and their larval young, the glow-worms. From the preceding statement it is evident that the "glow-worm" is not a worm; neither is its cousin the "glow-worm" of Europe, so often met with in prose and poetry. The latter is merely the wingless female of a Lampyrid beetle. In fact, all fireflies belong to the *Lampyridæ*, a name derived from a Greek word which means "to shine." It may surprise some to learn that this subfamily has more than fifteen hundred species of fireflies; and two hundred and thirty of these, distributed among forty-two genera, are from the United States alone.

To what purpose many light-producing animals are endowed with this remarkable power is open to much conjecture. Where an apparently valid reason can be ascribed in some instances, the same cannot be maintained in others. Thus, for instance, in fireflies this function was presumed to enable the sexes to identify each other in the darkness of the night, at which time their activities are greatest. If this be true, why, in the case of those species where the female is wingless, does the male emit light? Her inability to approach him surely would seem to indicate that the flashing of his lantern avails him nothing.

Another instance of the purposelessness of this power is to be found in those abyssal types of crustaceans which are totally blind. In this connection, however, it may be mentioned that these sightless creatures are devoid of complex photogenic organs; their phosphorescence being due to a luminous secretion.

Again, certain deep-sea prawns were recently found whose luminous organs lighted only the gill cavities of the animal. What function they perform for the benefit of the owners, located as they are, impossible of shedding any external light, defies speculation.

Perhaps the most intensely luminous animal for its size is the small marine ostracod crustacean, *Cypridena hilgendorfi*. So powerful is the light from this creature that one part of the luminous gland in one billion six hundred million parts of water will give a visible glow to that medium. If a man possessed an organ which gave the same proportionate volume and intensity of light as in *Cypridena*, he could illuminate the area of a fair-sized city.

It has long been known that many fats, ethereal oils and alcohols emit light when these substances are slowly combined with oxygen at certain temperatures. With this hint it was inevitable that phosphorescence in organic materials could be produced artificially and in a way that would bear a close analogy to the principle involved in the organs of light-producing animals. Therefore the "pyro experiment" became a classic achievement in this direction.

Pyrogallol, an organic compound of vegetable nature, is commonly known through its use as a developing reagent in photography. If pyro or gallic acid and hydrogen peroxide be mixed with the juice of any ordinary vegetable such as a potato, turnip, etc., a decidedly phosphorescent light occurs. Now as pyro is noteworthy for its property of combining with oxygen, it is at once apparent that what takes place here is a process of oxidization. It is remarkable, nevertheless, that although many compounds can be oxidized by a peroxide mixture, so far as known only pyro and gallic acid will oxidize with the production of light.

The next step in these most interesting experiments was taken with the photogenic organs of the animals themselves. Of all the light-producing animals, perhaps none has lent itself more to inquiry than one of our commonest fireflies, *Photuris pennsylvanica*.

Dissection of this insect shows that the photogenic organ consists of thin layers of light colored transparent tissue which overlie a deeper and opaque region. The function of the former seems to be for the transmission of the light, and the latter is both a reflector and the fuel generator. For intimately connected with this area is a network of air tubes, nerve terminals and the glands which secrete the globules of luminous compounds. These compounds have been separated in the laboratory and have been found to consist princi-

(Continued on page 70)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

White Yolks of Eggs

To the Editor of the SCIENTIFIC AMERICAN:

I hope you will pardon some further correspondence from me concerning pigments, but a note entitled "White Yolks of Eggs" in the May 14th issue of the SCIENTIFIC AMERICAN has attracted my attention. It struck me as most peculiar that it was necessary for the SCIENTIFIC AMERICAN to quote the German *Umschau* in regard to work by *American* investigators. The work which was cited was published by me in a series of three papers in the *Journal of Biological Chemistry*, Vol. 39, pp. 299-377, 1919, and also in the *Proceedings of the National Academy of Sciences*, Vol. 5, pp. 582-587, 1919. The experimental work was performed at the University of Missouri with which I was formerly connected.

I have noticed that scientific data sometimes gather inaccuracies in restatement a good deal like the proverbial stone. Permit me to point out several such errors in the article entitled "White Yolks of Eggs" which was evidently a translation from the German.

The first error is inconsequential, but pertains to the reference to myself and Professor Kempster as poultry breeders. This may apply to Professor Kempster, who is Professor of Poultry Husbandry at the University of Missouri. I have no objection to the title for myself, but I fear that the men actually in the profession would resent my being so considered. Another trivial error is the reference to the ear lobes of fowls as *earlaps*. I am sure the poultry folks would not agree to this terminology. A third error is more serious for it involves a scientific fact. The natural yellow pigment of egg yolk is *not* carotin, but xanthophyll, the carotinoid which is closely related to carotin and almost always associated with it in plants. It so happens, however, that carrots contain very little xanthophyll, so little, indeed, that when carrots are fed to laying hens, there is practically no effect on the color of the egg yolk (see paper by me in *Journal of Biological Chemistry*, Vol. 23, p. 261, 1915). On the other hand, yellow corn is very rich in xanthophyll with very little carotin so that the feeding of yellow corn greatly enhances the color of egg yolks. Both carotinoids are present apparently in green feeds so that the latter readily increases the color of egg yolk when fed to laying fowls.

A curious physiological fact in connection with these relations is that the natural yellow coloring matter of milk and butter *is* carotin and this carotin bears similar relations to the feed of the cow that the xanthophyll of egg yolk does to the feed of the hen. In this case, however, carrots greatly increase the color of butter, but yellow corn has no effect (see papers by me in *Journal of Biological Chemistry*, Vol. 17, pp. 191-249, 1914).

Finally, the whole story of white yolk eggs is not quite true after all. As far as being free from natural yellow pigment derived from the feed is concerned they were white. The yolks of cooked eggs were perfectly colorless, but the raw yolks contained a very slight amount of yellow coloring matter which could be extracted with suitable solvents, so in reality from a strictly scientific point of view the yolks were not *absolutely* colorless. This "trick" is, I fear, hardly attainable, for the hen apparently makes a little, although very little to be sure, of her own egg yolk coloring.

LEROY S. PALMER, Ph.D.

University, Minnesota.

The Lunar Zodiacal Light

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to an item, "Lunar Zodiacal Light," in your issue of June 11, summarizing part of my report to the director of the aurora and zodiacal light section of the British Astronomical Association. The following comment by Mr. Gavin Burns, director of that section of the B. A. A., is quoted: "As the light of the full moon is only about one-millionth the intensity of sunlight it is difficult to believe that the phenomenon described can be due to the light of the moon."

Chaplain Jones, U.S.N., was a specialist in zodiacal light observations. His report of observations made during the U. S.-Japan Expedition (1853-1855) forms Vol. III of the Expedition Report published in 1856, and contains 328 observations charted and described. The range of latitude extended from 42° N. to 53° S. Nearly 50 per cent of the observations were made within the tropics. He is very particular in describing what he calls the moon zodiacal light which he witnessed in the tropics. He also witnessed what he termed a joint sun and moon zodiacal light. In his report of one of these observations he says: "The moon quartered today (March 6, 1854; lat. 25° 26′ N., long. 139° 42′ E.). At half past 7 I was astonished to see the zodiacal light fully displayed. It was no doubt a joint sun and moon zodiacal light. . . . My mind was perfectly satisfied that it was clearly a zodiacal light. It differed from the ordinary zodiacal light in not being brightest at its lowest end but was all the way down of a fairly uniform brightness. It was quite distinct. The upper end was lost in the moon's superior light. The night was very clear." Naval officers corroborated this and similar observations. As to my observation in southern Maryland on the evening of February 21, 1916, of which I retain a vivid recollection. The moon was three days past opposition in right ascension 12 h. 9 m. and declination 5° 42′ S. The fact of the light was unmistakable. The sky was cloudless and the seeing remarkably good. The moon was the only source of light sufficient to produce the effect. Hence it seems quite appropriate to describe it as a lunar zodiacal light.

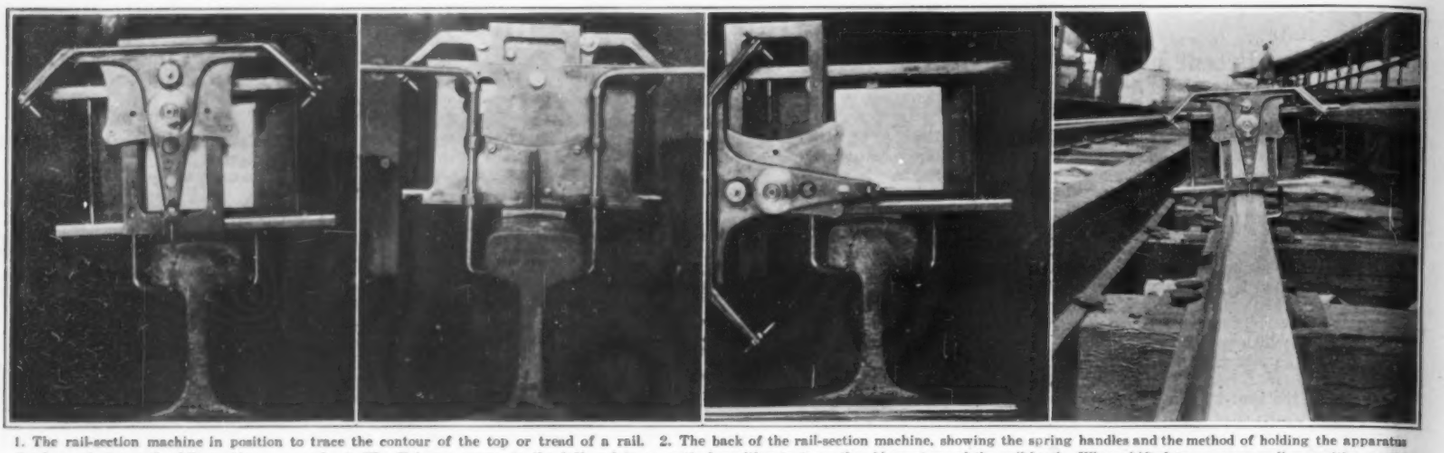
Baltimore, Md. W. E. GLANVILLE.

Substitutes for Wood in Papermaking

To the Editor of the SCIENTIFIC AMERICAN:

In connection with my paper article in your issue of June 11th, may I point out that in considering substitutes for rags, wood and straw, it is important to bear in mind that, while many plants, grasses, reeds, etc., are capable of being utilized in the manufacture of a satisfactory paper pulp, freight charges from point of production to mill must be less than the freight charges on pulpwood; a sufficient yearly growth must be assured to operate a mill continuously; and the cost of chemicals used in production must not, for example, exceed that involved in the pulping of straw; while a *sine qua non* is that the yield of cellulose fibers must amount to more than one-quarter of the total bulk of material treated. This at once rules out many of the hasty and ill-considered suggestions and propositions that have been put forward.

New York. THOMAS J. KEENAN.



1. The rail-section machine in position to trace the contour of the top or trend of a rail. 2. The back of the rail-section machine, showing the spring handles and the method of holding the apparatus firmly against a rail while making a record. 3. The T-frame swung to the left and in a vertical position to trace the side contour of the rail head. When shifted to a corresponding position on the right, the apparatus is ready to record the contour of that side of the rail. 4. The rail-section machine in service and about to record the wear of a rail at a troublesome point on a curve

Some phases of the application of the rail-section machine in determining rail wear and tear

Reporting the Life Story of Rails

How Railroads Employ the Rail-Section Machine for Determining the Wear and Tear on Their Tracks

By Robert G. Skerrett

THE incurious commuter, the accustomed traveler, and the shipper generally give precious little heed commonly to what might be termed the minor aspects of railroading upon which transportational safety, comfort, and economy of operation depend. The disposition of the public is to take much for granted in the management of our vast network of land lines, largely because their security en route and the proper and prompt carriage of their commodities are assured as a rule. But back of this record of work well done is a story of ceaseless vigilance; and the object of this article is to describe an ingenious apparatus which makes it possible to detect wear and tear in certain vital directions related to the maintenance of way and the efficient upkeep of the rolling stock.

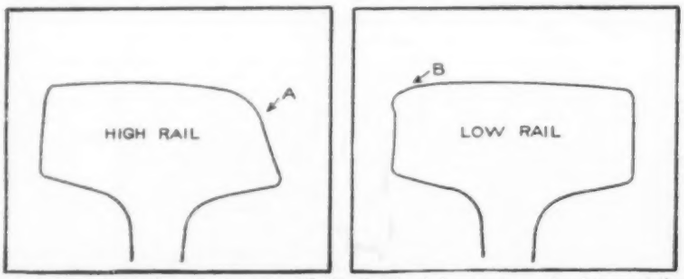
Considering the masses in motion and the speed at which trains of various sorts move, there is, indeed, ample warrant for wonderment that the ribbons of steel are capable of supporting and guiding the fast expresses and the pounding freights, and no less astonishing is the fact that the comparatively thin flanges of the whirling wheels are the sole mediums relied upon to hold the locomotives and the cars upon the rails. Neither the track nor the wheels would answer for these exacting purposes if both were not kept fit for the service expected of them.

Not only is the gage or distance between the track altered as a rail head is worn or deformed by the blows and friction of the passing wheels, but these modifications may lead to two things: they may cause the rail to fracture or they may induce the derailment of a train—an accident that may range from a delaying mishap to an appalling disaster. Again, if watchfulness is not continually directed to the wheel flanges these may be so ground down as to make them likely to break when suddenly subjected to lateral pressure in taking a curve or when passing over a switch or frog point. This is fairly certain to bring about a derailment. And now let us see what it is that one of our great trunk lines employs for the frequent examination of its rails and the wheels of its cars and locomotives.

The rail-section machine, as such, is not a novelty—the Germans having been the first to devise an apparatus of this nature; but the older instruments have uniformly been heavy and cumbersome and so troublesome to function that no one wanted to use them except when forced to do so. Further, they have been notably limited in their field of application—in short, helpful only in registering the condition of a rail head. Appreciating these drawbacks, Mr. B. F. Duel, one of the track engineers of the New York Central Lines, set about some years back evolving a modified mechanism that would be much lighter than any existing rail-section machines and which, besides, would answer just as readily for recording the state of the tread and the flanges of the rolling-stock wheels.

After considerable study, Mr. Duel produced his perfected apparatus five years ago; and the little machine weighs complete but seven pounds. Its less flexible competitor at that time tipped the scales at 30 pounds. The present instrument can be tucked away in the bottom of a handbag and can be brought into action in a few seconds. This is of much importance on a busy railway where the interval between trains is not long and where many of them travel at high speeds.

On the main line of the New York Central Railroad, between New York City and Buffalo, records are made by means of the rail-section machine at approximately 400 points. The object is thus to get an index of traffic influence on the rails at these characteristically troublesome positions along the line. The practice is to register graphically the condition of the several rails or tracks at each of these places, and then to inspect in the ordinary way the trackage lying a short distance beyond in both directions. The closeness of this examination is determined by what the rail-section card reveals.



The sections of opposite rails on a curve 2° 46′. Left-hand drawing is a reduced trace of the contour of the high outer rail. *A* indicates where the side pressure of the flanges of the passing wheels has ground away the metal. The right-hand drawing is a reduced trace of the low or inner rail. *B* shows where the over-riding action of the wheels causes the metal to flow outward while at the same time grinding away the tread

How the rail-section machine reports the story of rail wear

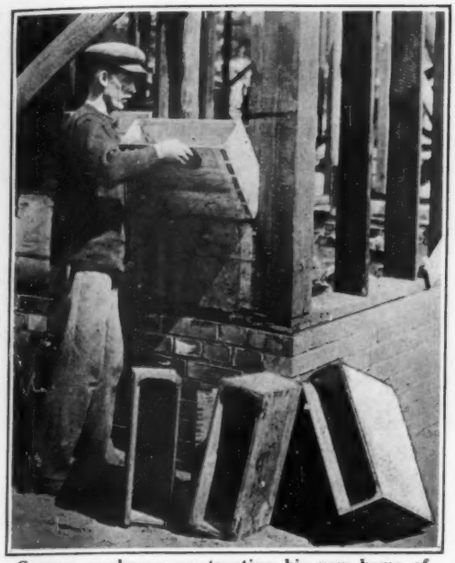
Because of the seasonal convenience and the facility with which labor can then be obtained, it is customary to lay new rails in the summertime. Then the effects of traffic upon these rails are checked up by the apparatus the next spring. By this procedure it is feasible to get a good idea of the wear and tear of half a year's service. The real significance of the records of the rail-section machine becomes apparent when the tonnage that has been moved over the rails during the previous six months is compared with that of the year before and the state of the track at that time. Assuming the traffic at both periods to be the same, then the engineers of the Maintenance of Way Department can tell, according to whether the new rails are showing more or less deformation, just how well these steel members are meeting the road's requirements. With such a system of surveillance in operation continually, and rails are normally expected to stand up for a number of years, each succeeding record, in combination with the tonnage carried for a given period, adds another page to the life history of the rail in question. It discloses how and when to take steps to neutralize or to offset the grinding and the pressure of car and locomotive wheels.

On the New York Central Railroad's main line the maximum curves are of 7 degrees, while upon tributary coal lines the curves are frequently of from 10 to 12 degrees, and there are places along these sinuous routes where the bends are of 14 degrees. Indeed, there are long stretches of this railway system where the straight or tangent sections do not represent more than 40 per cent of the run. Therefore, it is essential that the curves be looked after with the utmost care, for the rails at these points are subjected to the greatest stresses and the most abuse. Besides furnishing data covering the effects of different services upon the rails; bringing out the special physical conditions that must be met at particular points; detecting whether or not the rail is giving a maximum of usefulness; and settling disputes between section bosses and inspectors as to the fitness of a rail to remain in place, the rail-section machine determines to a nicety whether the rail can be reversed and used in the same division or if it would be wiser to shift it to another track where the traffic demands are less trying.

By the timely reversing or transferring of rails, as the case may be, the men of the Maintenance of Way Department are able to get the fullest measure of use out of the rails before they are scrapped. This procedure makes for very substantial economies in the upkeep of the roadbed; and the systematic and intelligent employment of the rail-section machine is thus instrumental in saving many thousands of dollars annually. Before describing the adaptation of the apparatus to the recording of the flange and the tread contours of wheels, let us explain briefly the general get-up of the machine.

Broadly, the instrument is composed of a light metal main frame carrying a hollow sliding frame which moves horizontally on roller bearings, and this sliding frame, in turn, supports an adjustable T-frame which can be set to travel either horizontally or vertically. This T-frame holds a pencil point centrally located, while at the three extremities of the T-frame are mounted adjustable pins. These pins, according to the position of the T-frame in relation to the rail, come successively in contact with the top and the two sides of the rail head, and as they follow the contours the pencil reproduces on a card the exact outlines of the rail. At the back of the apparatus are two spring handles which terminate at their lower ends in hooks.

(*Continued on page 70*)



German workman constructing his new home of former munition boxes

From German Munition Boxes to Workmen's Houses

NEAR Eberswalde, Germany, the building shortage is being met through the erection of unique houses —unique because of the material being used in their construction. The accompanying photograph shows that Eberswalde workmen are using old munition boxes in constructing new homes, in place of bricks which are very costly and difficult to get. The new houses are constructed by first erecting a framework, as shown in our photograph, and then filling the framework interstices with old munition boxes. It appears, too, that the munition boxes are filled with concrete so as to make the construction highly substantial. The munition boxes are so well made, with their heavy wood and mortised corners, that the wooden "bricks" filled with concrete make an ideal wall.

What Is the Aurora Borealis?

AS early as 1881 the idea was put forward by Goldstein that the sun sends out into space streams of electrically charged particles, which may give rise on the earth to electric and magnetic phenomena. In 1893 Poulsen applied more or less the same theory definitely to the aurora borealis. Birkeland, however, was the first to give a real basis to the theory that the aurora is due to electric discharges from the sun.

Birkeland discovered, in 1896, that a magnetic pole will concentrate a beam of light rays at a single point, much after the manner of a lens. The suggestion was immediate in his mind that the earth, acting as a huge magnet, might in like manner concentrate cathode rays or similar electric radiations from the sun, bringing them, of course, toward the northern and southern magnetic poles.

Physical confirmation for this theory was secured by Birkeland in 1901. In a large vacuum glass jar he suspended a small magnetic sphere, and directed toward it ordinary cathode rays. While the sphere remained unmagnetized, the rays touched only one-half of it, over which they distributed themselves uniformly quite as might be expected. As soon as the sphere was magnetized the rays distributed themselves in horn-like bundles, the points of which lay in ring-shaped zones about the two poles. The correspondence between the illuminated areas of the sphere and the north and south auroral belts of the earth was very close.

Birkeland's first idea was that the aurora was due to secondary cathode rays, originating from vast systems of electric currents in the extreme uppper atmosphere, which in turn were formed by cathode rays from the sun. Later he amended this theory to the extent that he came to regard the aurora as itself produced directly by the cathode rays from the sun. By 1913 he was committed to this alternative.

In the meantime Carl Störmer interested himself in his colleague's work, and being a mathematician he began to wonder whether it would not be possible by pure mathematical means to obtain the details of Birkeland's experiments, and to discover the essential characteristics of the auroral phenomena. The results of his investigations were published gradually over a term of years. Broadly speaking, the problem was visualized as one in the dynamics of moving particles—the electrically charged particles from the sun; and it was of course treated by considering the differential equations that define the motions of such particles. The "integration" of these equations, as the process of solving them is called, is a very long and complicated one. About as close as one can come to explaining to the layman why this should be so is to explain to him that in each equation there occur not one, but a number of unknowns (the dependent and independent variables and the derivatives of the former); that there exist between these definite relations, but relations of such a sort that the numerical values of some of them do not aid us at all in finding the values of the rest until after we have solved the equation, and do not aid us in this solution either; while the equations themselves have to be considered in groups, and do not yield at all to direct algebraic attack. What has to be done is to find, by a lengthy process of trial, algebraic expressions for the relations that are known to exist between the unknowns, and of such character that they will satisfy the conditions laid down by the several differential equations of the system under consideration. These algebraic expressions turn out in practically every case arising in practice to be infinite series, and the computer has to discover the terms of these series one at a time, by laborious calculation of

Special camera employed in making photographs of the aurora borealis

the coefficients, and to proceed until he has assured himself that he has enough terms so that his numerical results are a sufficient approximation to the truth. It is not an easy or a pretty process, and one who knows differential equations can easily credit Störmer's statement that the work had to be subsidized by the Nansen Fund, and that 5,000 hours of calculation were used up on it—an enormous task, to be sure.

The object would naturally be to determine those trajectories which could be taken by electrically-charged particles from the sun, under the influence of the sun's and the earth's magnetic and gravitational fields, and which would bring the particles following them into actual contact with the earth. Of course such trajectories taken at random would display a large preponderance of probability in favor of missing the earth; and in fact the investigators found that the few trajectories they could get to hit the earth did not throw sufficient light upon the problem, and that it would be necessary to work it backwards, starting from the earth with paths known to have arrived at the earth, and tracing these back to see how the corresponding particles had left the sun and how they had behaved on approaching the earth. This method of attack upon the problem was a complete success, and a complete mathematical characterization was formu-

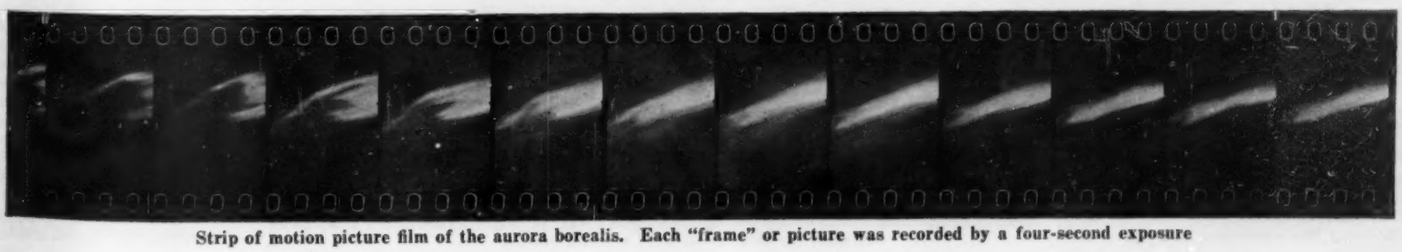
(*Continued on page 71*)

Apparatus employed by a railroad repair shop for the purpose of cleaning out boiler scale

Using Sand, Compressed Air and Water to Clean Boilers

A DEVICE has been perfected and placed in operation by the Southern Pacific Railroad in which water at 125 pounds' pressure is mixed with compressed air and sand, and the mixture directed against boilers and boiler flues by a special gun, the purpose being to clean the scale from the flues and boiler. By means of this combination the scale is not only entirely and quickly removed, but as it is removed it is washed down with the water and sand, leaving the flues and boiler perfectly clean. There is no dust or sand floating around in the air, as is the case when sand is used with compressed air alone. By this new system other workmen can work within a few feet of the sand, air and water gun without being inconvenienced in the least.

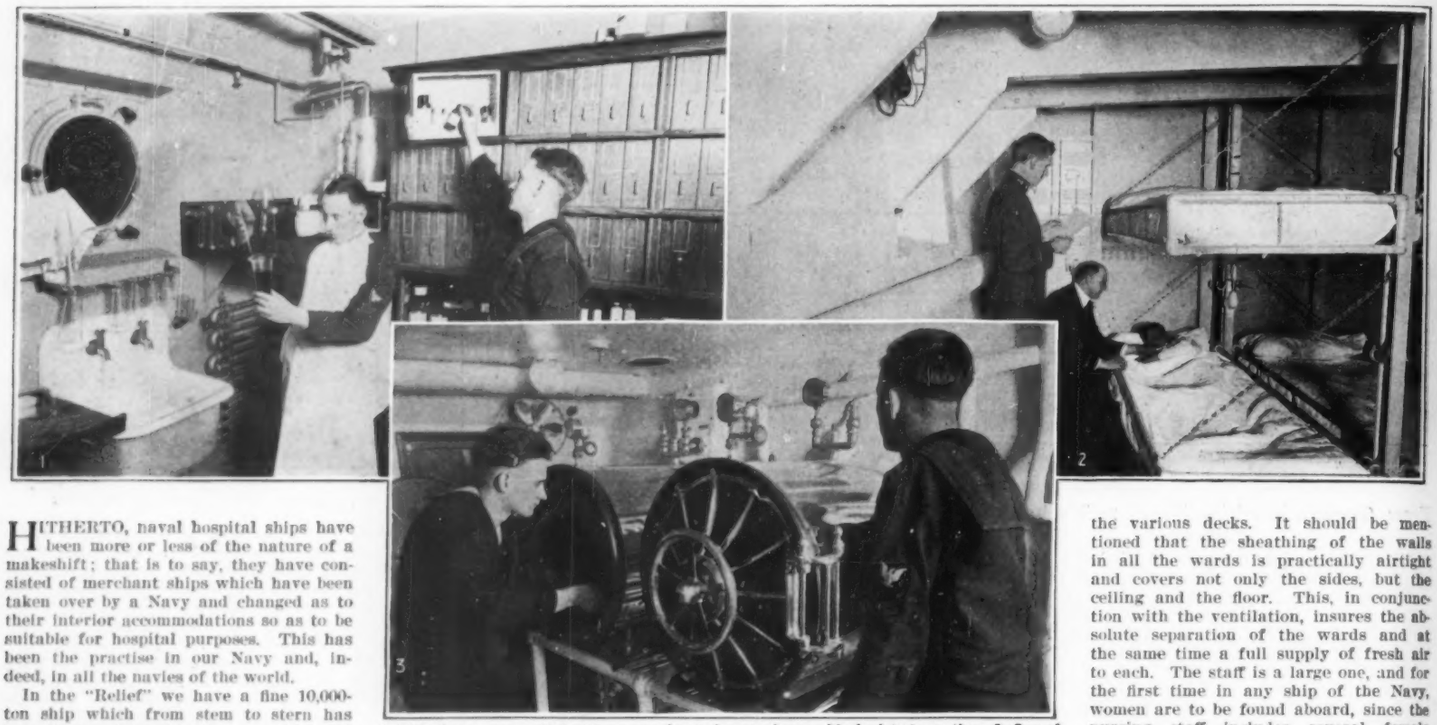
In the view shown above *A* indicates the hose that delivers water at 125 pounds' pressure to the gun, while *B* indicates the hose that delivers the sand under air pressure to the gun, and *C* indicates the hose that delivers air alone to the gun. The entire equipment is mounted on a four-wheel truck, enabling the equipment to be readily taken from one job to another. The sand is placed in the metal drum, and then compressed air is turned into the drum, which serves to deliver the sand into the gun where it is caught up by the air pressure and the water pressure and directed against the parts of the flues or boiler to be cleaned.



Strip of motion picture film of the aurora borealis. Each "frame" or picture was recorded by a four-second exposure

Our Floating Hospital

Some Features of the United States Navy Hospital Ship "Relief" Built Specifically for Hospital Purposes



1. The pharmacy, provided with metal cabinets in accordance with the latest practice. 2. One of the sick bays. 3. Scene in the sterilizing room

Some features of the Naval Hospital ship "Relief"

HITHERTO, naval hospital ships have been more or less of the nature of a makeshift; that is to say, they have consisted of merchant ships which have been taken over by a Navy and changed as to their interior accommodations so as to be suitable for hospital purposes. This has been the practise in our Navy and, indeed, in all the navies of the world.

In the "Relief" we have a fine 10,000-ton ship which from stem to stern has been designed specifically as a hospital ship. Our naval constructors claim, and with very good reason, that she is not only the latest, but the most perfectly equipped vessel of her kind afloat. Before drafting out her plans a very thorough study was made, not merely of other hospital ship practise, but of the latest hospital practise in the big shore establishments both of the Navy and of the various municipalities. Consequently, from the hospital standpoint, the "Relief" represents up-to-date practise in the arrangement of her wards, operating rooms and general equipment. She was built as a fleet hospital ship—that is to say—she will accompany our fleet upon its cruises and will be always at hand to receive, care for, and bring back to health such members of the personnel of the fleet as may be injured or otherwise placed temporarily on the sick list.

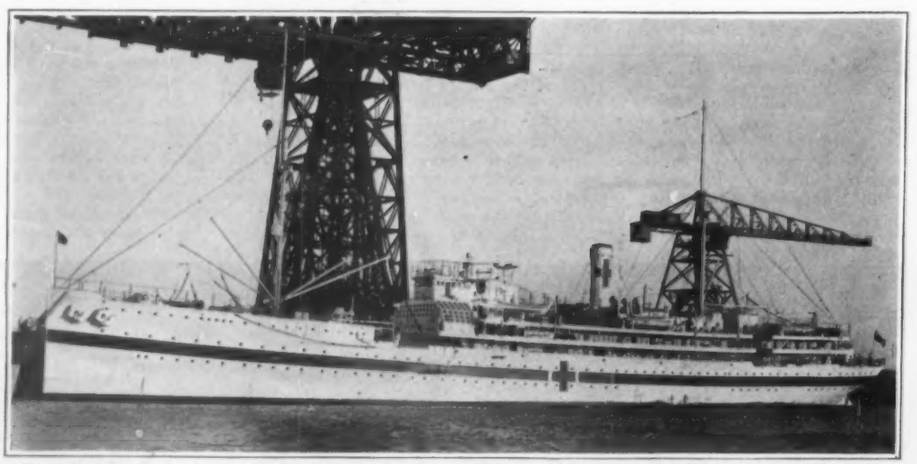
The "Relief" is 460 feet long between perpendiculars and 483 feet overall. Her beam is 61 feet, her molded depth 39 feet, 3 inches, and her draft 20 feet. On this draft she displaces 10,000 tons, and her speed is 16 knots. On looking at the photographs of the ship, the eye is at once caught by the large perforated structure below the bridge. This encloses the operating room, and the dark spots, numbering about 100 in all, are large, two-foot portholes, which cover the whole top and sides of the structure. In the room are two tables and two smaller operating rooms. A special system of shades is provided, so as to enable the surgeons to get exactly the light which they require, both as to quantity and direction. It is needless to say that this room contains the very latest operating equipment.

The ship can accommodate 500 patients, and it is divided into three distinct sections for the officers and staff, the crew, and the patients. The contagious disease wards are carefully separated from all the other wards, being located aft on the upper deck.

Among the specialties on the ship are the "mechanical cow," a device for producing synthetic milk, which cannot be distinguished from ordinary milk either in taste or quality. This is produced in quantities for the use of the patients. Also the ship contains hydro-therapeutic rooms, dental rooms and eye, ear and nose rooms, en suite, the ear rooms being made sound proof. There is even a mortuary in which twelve bodies can be refrigerated.

Carefully screened off from all other compartments is the X-ray room, most elaborately fitted and lead-lined throughout. In a remote part of the ship is an animal pen for the production of serums.

Every possible thing has been done on the "Relief," not merely to assist the surgeons in doing rapid and effective work but to render the hours of convalescence as comfortable as possible for the patients. Particular attention has been paid to the lighting, which has been so hooded as to throw the light away from the patients' eyes. A special system of quadruple-flow ventilation has been built in the "Relief." She has been supplied with several elevators running through the various decks. It should be mentioned that the sheathing of the walls in all the wards is practically airtight and covers not only the sides, but the ceiling and the floor. This, in conjunction with the ventilation, insures the absolute separation of the wards and at the same time a full supply of fresh air to each. The staff is a large one, and for the first time in any ship of the Navy, women are to be found aboard, since the nursing staff includes several female nurses. The "Relief" is a large ship, but none too large for her duties, even in peace maneuvers. The personnel of a fleet, with its auxiliaries, runs to large figures. A single modern battleship houses over 1500 officers and men.



U. S. S. Naval Hospital ship "Relief"—10,000 tons, 15 knots. This is the first ship in any navy to be designed specifically for fleet hospital service

Use of Photographs in Swiss Advertising

SWISS business firms display great talent in artistic advertising. Wrappings are not only always neat and appealing in subject, form, and color, but the pictures and photographs, whether accompanying sales or used as display advertisements, are particularly attractive. These in almost all cases portray some well-known national event, or some artistic and historic piece of natural scenery. The big chocolate manufacturers and watchmakers of Berne are particularly adept in appealing to the eye.

The Swiss have learned more thoroughly than the American manufacturer and seller that no amount of expertly written description of anything, whether it be machinery, chocolate, a watch, or a music box, can tell the story as well as a good photograph. The principal reason of this is due, not so much to a greater imagination and artistic temperament, as to a conscious feeling that among so many different European languages a universal appeal has a greater and a more attentive audience. For example, to an American machinery company a visualization to the foreign buyer of American export machinery would certainly be of value in impressing non-technical men such as the average European board of directors and even skilled engineers.

American articles sold to Switzerland, as well as those sold throughout all Europe, yield themselves easily and readily to the photographic idea. If the commercial travelers in the United States are now finding that the picture method yields such increased business, it would be equally advantageous if used abroad.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Running the vacuum cleaner over automobile upholstery for a thorough cleaning

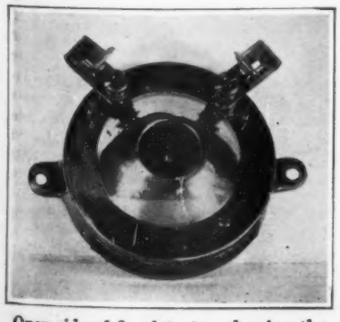
A Vacuum Cleaner for the Automobile

CONSIDERING the expanse of upholstery in the average automobile, and more particularly the little corners and pits in which dust accumulates and resists most efforts to dislodge it, there is a clearly defined field for the vacuum cleaner designed for automobile use. The accompanying illustration shows a vacuum cleaner for automobiles, that has recently been introduced. The outfit consists of the dirt container, a connection with the intake manifold of the engine, a long flexible hose and the nozzle. The nozzle is run over all parts to be cleaned and the dust is sucked up and delivered to the dirt container. The dirt container can be removed with a twist of the wrist and the contents emptied. The dirt container can be installed under the hood or under the dashboard, as shown in the illustration.

An Automatic Fire Alarm for the Home

THE ever-present danger of fire in the usual frame building or house can be reduced to a large degree by providing means for detecting fire at its very inception. Among the various fire-detecting devices that have been placed on the market is the type shown in the accompanying illustration, which has simplicity and dependability to recommend it.

This new fire detector closes any circuit in which it may be connected when the air in the immediate vicinity rises above a certain predetermined point. Thus the outbreak of fire may be signaled by the ringing of a special fire bell or the regular house bells. Any number of detectors may be installed on one circuit in parallel, or on separate circuits connected with an annunciator so as immediately to indicate the exact location of the fire. In this manner this device becomes available for the average home, where a detector can be placed in the cellar to guard against fires, or in the average factory, store, school building and so on, where a number of units are required.

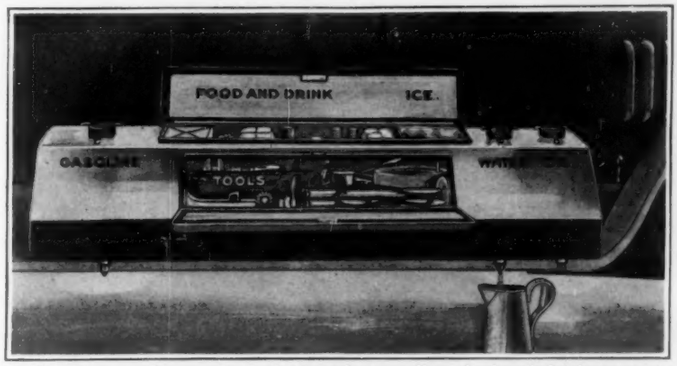


Open side of fire detector, showing the lugs that hold it in place and the wire connectors

Combination Tank for the Motor Gypsy

THE attractions of motor vacations and outdoor living lead many families to wander far from restaurants and fuel stations when adequate supplies for man and vehicle can be easily transported. A new combination tank has been designed to fit neatly upon the running board, without interference when entering the car. In one model of automobile this tank is standard equipment and a place has been made for it at the rear of the chassis.

In the center of the handy carrier space is provided for provisions, together with ice to cool food and beverages for the day's journey. Another compartment holds tools. Any one who has ridden beside the driver and had to climb out every time a wrench was required from the box beneath the seat will appreciate the tool compartment feature. Three other spaces carry a reserve supply of gas, oil and water, each liquid being quite independent of its neighbors and drawn off through key-lock faucets. Locks are attached to both tool and "grub" containers.



Combination gasoline, water and oil tank, as well as food and drink compartment and tool chest for the long-distance automobile tour

Speeding Up the Picking of Apples

FROM England comes the accompanying photograph of a new labor-saving device in the form of an automatic apple picker. This machine consists of a number of parallel chain belts which carry numerous cross-arms set at regular intervals apart, the cross-arms being provided with springy fingers. The front end of the automatic picker, which is carried on a pair of bicycle wheels, is close to the ground and terminates in a number of spring fingers. As the machine is wheeled along the ground beneath apple trees, the apples are caught by the lower spring fingers while the belt-mounted fingers, moving all the while, come down and round the front in such a manner as to scoop them and carry them up the incline rails to the bin at the center of the little machine. The belts are driven by a chain belt which engages with a sprocket on the bicycle wheel shaft. It is reported that the apple picker does the work of six men, picking up 40 pounds of apples in 1½ minutes.

Pneumatic or Solid Tires for Motor Trucks?

RECENT announcements of motor truck builders show that considerably more interest obtains on the part of truck users regarding the advantages to be secured by using pneumatic tires on heavy vehicles than is generally believed. The president of a prominent concern making solid tires shows in a recent letter that this form is superior for certain classes of work, especially where very heavy loads are to be carried.

The practise of overloading motor trucks is almost universal and it is very questionable whether such a deep-rooted and general habit can ever be eradicated. Most power wagons are designed to carry a reasonable overload and stand up under the abuse which the average motor truck receives. So are solid tires. In other words, solid tires are foolproof and for freight transportation, the simple, foolproof part is only just good enough. Pneumatic tires are far from foolproof. They will not stand such abuse.

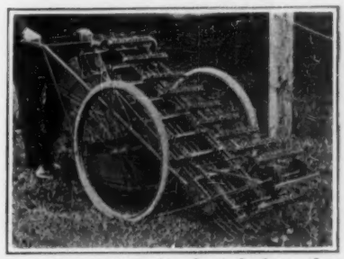
It seems a good view to hold that solid tires fill a totally different need than pneumatics and that the two will continue to exist alongside each other, each in its proper place. In deciding on their tire equipment motor truck owners are best advised to render an account themselves of their particular service requirements. If the motor truck is intended for city hauling, they will undoubtedly obtain the best results out of solid tires, generally speaking; whereas, for long-distance hauling, it is largely a question of load. For heavy loads again the solid tire is the logical equipment, whereas for light hauling, and particularly in the case of perishable goods, the pneumatic tire is the better choice, provided always that the increased speed to be obtained out of pneumatic tires can be fully utilized to compensate for the increased cost of tire up-keep.

Recent Patent Decisions

Interference.—Herein is an appeal from a Patent Office decision in an interference proceeding awarding priority to the senior party, Yardley. The invention relates to synchronous booster rotary converters.

The Board of Examiners reached the conclusion that Yardley was the first to conceive and the first to reduce to practice this particular invention. Counsel for the appellant contend that the mere fact that Yardley was the first to conceive and first to reduce to practice is not sufficient ground upon which to base an award of priority to him.

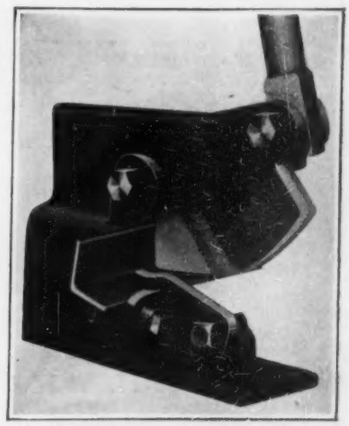
The court herein holds that the Board of Examiners were right in their contention, and the mere fact that one was the first to conceive and first to reduce to practice is sufficient ground on which to base an award of priority. *Reben v. Yardley. U. S. C. C. A. of D. C.*



As this machine is wheeled along the ground it picks up apples and delivers them to a hopper

Something New in Angle Shears for the Small Shop

A CHICAGO manufacturer has just introduced a new angle shear which, it is claimed, is different from any other on the market. The upper shear blade of this machine is actuated by a geared lever. The blade is also reversible and has two cutting edges. An important feature of this shear is the fact that the upper blade can be raised high enough so that the angle to be cut can be inserted from the front of the machine. A hold-down is provided for keeping the angles in place while they are being cut. Weighing only 22 pounds it is claimed that it is less than one-third the weight of any other angle shear. The machine will cut angles 1½ inches x 1½ inches x 3/16 inch and lighter.



Cutting angle iron with a new type of angle shear. Note how the angle is securely held in position

Pulling the Mississippi's Teeth

(*Continued from page 60*)

The wood work of the boat was also well preserved. The water does not seriously injure the metal or wooden parts of a sunk ship; it is the mud which effects the bulk of the damage. Wrecks which are not imbedded in the mud and sand survive decomposition for many years. During the periods when snag work on the river is not pressing, the snag boats occasionally assist private companies in the raising of river boats which have been sunk at sections of the river adjacent to the open channel. Such assistance is furnished at actual cost.

Despite the great increase in labor costs, Congress appropriates the same amount for snag removal from the Mississippi today as 30 years ago. The consequences are that the two snag boats which are supposed to patrol the river from St. Louis to New Orleans are not able to work a full season—the snagging season usually lasts from July until March. Lack of funds is halting this essential work just at a time when the Mississippi River is being used more than ever before. It is now highly necessary to keep the channel clear and navigable and to do everything possible to promote the increased utilization of this wonderful inland waterway. It would seem that Congress might allot a few thousand dollars more a year to this meritorious cause.

Just to show that the money used in the past has been effectively expended, it may be cited that during a normal season, the two Government snag boats on the lower Mississippi will pull and destroy between 300 and 400 snags, the average weight of these obstacles being between 30 and 40 tons. In addition, they will break up anywhere from 10 to 20 drift heaps which—if neglected—are inimical to navigation. The crews of the two boats in addition will cut between 200 and 10,000 trees which fringe the banks and are liable to be undermined and washed away by the river and ultimately converted into dangerous snags. The conquest against snags in the open channel is well in hand, at this time, and with sufficient funds to continue the work it will be possible to keep the number of acidents due to snags down to a minimum. However, to neglect the work at this stage of the game due to lack of funds is a costly, senseless and unnecessary error. The American public desires that Congress reduce expenses along sane and sensible lines. It does not wish our legislators to rob Peter to pay Paul in the style evidenced by the 1921 lack of adequate appropriation for the complete and efficient removal of snags from the Mississippi.

What Makes the Glow-Worm Glow?

(*Continued from page 65*)

pally of two substances which are termed "luciferine" and "luciferase."

It was formerly believed that since phosphorescence took place on the oxidization of oils in alcoholic solutions of an alkali, that the material which was oxidized in photogenic organs were fat droplets; but since the separation of luciferin and luciferase, neither of which can be reduced by such fat solvents as ether, benzol, etc., it is, of course, now known that such is not the case. Of the two substances liciferin is the more stable. It will withstand long continued boiling, and will remain unimpaired in its light-producing quality for months. Furthermore, after it is oxidized it is converted into "oxyluciferin," and this latter product can in turn be reconverted into luciferin. Luciferin, however, will oxidize with light production only in the presence of luciferase. Luciferase, on the other hand, is very unstable and deteriorates rapidly.

It will, of course, be obvious that the presence of oxygen is necessary in order that luminescence in the photogenic organ can take place. Therefore, we may with great probability determine by inference just what takes place during the flash of the firefly's lantern. As the insect has stored in the glands of its organ a supply of both luciferin and luciferase in a combined form, there is always maintained a more or less steady glow due to the oxidization of the luciferin in contact with the ordinary oxygen absorbed from the air and the oxygen normally contained in the tissues. When the moment of the flash occurs there is an accelerated production of luciferase, during the combustion of which it is rapidly used up, and by a respiratory process the air tubes flood the photogenic cells with a copious supply of oxygen, no doubt operated under pressure.

Exhaustive tests with the bolometer and the spectroscope have shown that the light of Photuris, unlike our artificial illuminants, contain no heat rays and no light rays extending into the infra-red or the ultra-violet. That is to say, it is what is termed a "cold light" and that the only light rays which are emitted are those which are visible to the eye. In this respect, as an illuminating device the light of the firefly is tremendously greater in efficiency than any artificial light yet constructed. How great this efficiency is will be seen when the comparative values of some of our modern illuminants are given. In a photometric curve worked out some years ago it was found that the efficiency of the carbon glow lamp was 0.43 per cent; the tungsten lamp, 1.3 per cent; whereas the firefly had an efficiency of 99.5 per cent. It is evident then that our most efficient artificial light is not more than 4 per cent as efficient as that of the firefly.

A natural question here arises as to whether the light of phosphorescent animals can ever be artificially produced in a way to make it available for domestic and industrial use. To dismiss with contempt the possibility of synthesizing animal light would ill become anyone who has seriously reviewed the achievements of the past century. And confidently to anticipate that at no long distant date this will be accomplished, would be neither vain in the man of science nor presumptuous in the layman.

Reporting the Life Story of Rails

(*Continued from page 66*)

and the latter can be swung in under the head of a rail to grip it and to hold the machine firmly in place while making a record. The present instrument uses cards while the older machine traced the lines on tin plates which were subsequently inked and prints made therefrom. Besides being heavy and otherwise objectionable, the tin plates were expensive. Finally, the Duel mechanism, with its adjustable features, can be set to allow for wear. This insures the making of reliable records at all times and greatly prolongs the serviceable life of the device.

In the reading of wheels, whether car or locomotive, there is an auxiliary attachment called a punching frame, a triangular affair carrying three steel points. This is first fitted over the tread and flange, and a hammer blow on each punch leaves an enduring mark on the rim of the wheel. Next, an aluminum yoke or tire base is centered upon these three indentations, and then the rail-section machine is secured to this base. With this done, it is an easy matter to reproduce the outline of the wheel's tread and flange. The cards employed for this work are larger than those used in recording rail sections, and they can be repeatedly inserted in the apparatus with precision so that subsequent tracings can be made thereon to illustrate the various wearing stages of the wheel. Whenever this is done the instrument is set at the same spot on the wheel, as indicated by the permanent marks made by the punching frame.

On one face of every wheel there is a

ridge which is known to the railway fraternity as the "wear groove." This serves as a base line from which to measure the wear on the wheel tread; and down to a certain point a wheel may be worn before it must be condemned. When the rail-section apparatus shows that the wheel is not wearing evenly and that it may be made fit again by being turned down in a lathe, the wheel is sent to a shop for that purpose. There, the men that do this are paid on a piecework basis and agreeably to the amount of metal that has been removed. Not infrequently their claims for compensation are disputed, and the rail-section machine comes into play to settle the question. Further, the instrument is often relied upon to establish how much the wheel shall be turned down.

The wear on wheels is a sure index of the way wheels are mounted, and it is important therefore that this work be done correctly. In a locomotive, for instance, the wear on different wheels, when not uniform, is unmistakable evidence of improper mounting somewhere; and this condition may be such as to hamper seriously the efficient and economical performance of that tractor. Happily, a rail-section machine, like that developed by Mr. Duel, makes it practicable to detect any irregularities in their insipiency and to take the steps needful to remedy them. Inasmuch as the locomotive is the prime mover, and all of its powerful tractive effort is exerted through its wheels upon the rails, it should be plain that when these wheels are not mounted aright they are correspondingly apt to be more destructive to the track. It is to the advantage of the railroad and to the benefit of the public that these harmful sections be checked at the very start in order to avoid outlays and accidents for which the people at large must pay sooner or later. The rail-section machine is proving a very valuable agency in this direction.

What Is the Aurora Borealis?

(*Continued from page 67*)

lated of the trajectories that would hit the earth. This was checked up with Birkeland's observations on the small sphere, and it was found that the mathematical results checked up exactly with his physical ones, and both, as stated above, with the aurora itself. Perhaps the most remarkable feature of these trajectories is the manner in which they circulate about the earth and descend upon the side opposite the sun to make the auroral apparition possible at night, on the side of our globe turned away from the sun that is responsible for the whole thing. The mathematical theory explains perfectly a number of the subsidiary features of the physical occurrence of the aurora, such as the occurrence in zones and the formation of the characteristic arcs and draperies. In a word, what we call the aurora borealis is precisely the light produced by the electric rays from the sun, under the resistance of the earth's atmosphere.

Dr. Störmer was not content to let his investigation of the aurora stop here, however. He took up the challenge implied in the fact that satisfactory photographs of these displays had never been made; and so effectively did he dispose of this challenge that he has, in addition to a large number of ordinary photographs, successfully obtained motion pictures of the aurora. The chief difficulty in still or motion pictures of this subject lies in the matter of exposure. Dr. Störmer's motion films of the aurora are unique in that each panel is exposed for four seconds before it moves on and gives place to the next one.

Dr. Störmer has contributed, to the SCIENTIFIC AMERICAN MONTHLY for July, an extensive account of his own and Birkeland's work with the auroras, together with a large number of photographs, both still and motion. The present discussion is a résumé of his text.

New Builders' Tape Added to Starrett Line

An addition to the Starrett line of measuring tapes is Builders' Tape No. 540, featured in the special list of new tools shown in the latest Starrett Catalog No. 22B. This tape, especially recommended for Builders, Contractors and Architects, is 62½ inches in length and is graduated with ⅛-inch scale from 1 to 500, on one side, and with ¼-inch scale from 1 to 250, on the other side. Each full tape may thus be taken to represent either a quarter or half a thousand feet, depending on the scale of the plans to which it is applied. This tape will be found very convenient, as by its use actual dimensions of any project may be easily figured from the plans.

For Those Desiring a Starrett Tape at a Moderate Price

the new "Yankee" Steel Tapes, No. 518, will be found very satisfactory. These tapes, also noted among the new Starrett Tools listed in the Starrett Catalog No. 22B, are ⅜-inch wide, in steel cases, covered with "Atholeather."* All "Yankee" tapes are equipped with folding flush handles and the handy "Starrett" push button for easy opening of handle. These parts, as well as trimmings are handsomely nickel plated. "Yankee" tapes are especially designed to provide a very serviceable tape at a moderate price. These tapes are furnished in lengths of 25, 50, 75 or 100 feet. Graduated in feet, inches and eighths of an inch.

Other Starrett Steel Tapes

Starrett Steel Tapes are supplied with or without cases in various styles and in lengths varying from 25 feet to 100 feet. Graduated in feet and inches on one or both sides; feet and inches on one side, and feet, 10ths and 100ths of a foot on the other; metric measure on one side, or both sides, or metric measure on one side and feet and inches on the other; feet, inches and 16ths of an inch, or other markings, on one side only; and in other combinations of markings.

*"Atholeather"

"Atholeather," made by the Athol Manufacturing Company, Athol, Mass., is a coated fabric made in close resemblance to various grades of leather. Is is used in place of leather for a wide variety of purposes, in many of which it is preferable to leather as well as being much less expensive.

Advertising on Airways

ENTIRELY fresh outlets for enterprises are becoming somewhat rare nowadays. All likely ground has been gone over so minutely that the discovery of a new pasture is something of an event. It is this fact that lends interest to the quite new idea of advertising on airways.

Thousands of people have this summer passed by way of the air between London and the Continent, and there will be many thousands more during this next year. Traffic is expected, in fact, to be quite trebled in volume. These air travelers are people to whom "time is money," people of discrimination, people to whom the shrewd advertiser would naturally turn. And as the "air age" we are now entering is likely also to be an age in which an even greater use is made of skilful advertising, any scheme which can, so to say, bring these two great ideas together will very clearly merit attention.

If one wants to advertise on an airway, where is the advertisement to be placed? It is clear that it cannot be put just anywhere one likes. There is the case already of one very enterprising but rather too precipitate concern which not long ago went to the trouble of painting a striking word on the roof of a building at one of the air ports. The company was much annoyed when the flying authorities stepped in and politely but firmly demanded the sign's removal. The reason for the request was simple. On one fringe of the landing ground, in large white letters capable of being read high in the air, the name of the air port had been placed, and it was specially necessary that there should be no confusion or any possibility of a mistake on the part of a descending airman as to the identity of the port he was approaching. It was thought that some foreign pilot, gliding down and seeing a large word painted on the roof of a building, might mistake the advertiser's announcement for the name of the port and wonder where he was.

One mentions such a point because it shows that nothing must be done that will clash with official guiding sign; nor may one send up kites or captive balloons, because the cables holding them might be fouled by aircraft.

So long as an advertisement does not conflict with traffic control the field is very wide and interesting. Schemes are in hand already for specially designed advertisements placed on the ground in the neighborhood of prominent air stations, while advertisers are also turning an eye to those points on the British and French coasts which pilots cross over daily on their way to and from Paris, Brussels, and Amsterdam. An advertisement which attracts the attention of an air traveler as he passes over England on a flight from the Continent is obviously good publicity.

While it is true that the airway is tied to no particular route as is a railway, it is equally true that the regular navigation of machines between two such cities as Paris and London does as a matter of routine, bring craft daily over almost identically the same tract of country. It is therefore perfectly feasible to take a map and say that if an advertisement is placed in a certain spot it will be on the line of air traffic.

It might be thought, perhaps, that airplanes fly so high that any ground advertisement would be rather a doubtful investment measured by the number of persons in the air who would actually catch sight of it, but from the normal cruising height of a Continental passenger airplane it should be perfectly easy to see and read a ground sign which is sufficiently large and has been designed to serve its specific purpose. Advertising position not far from air ports will no doubt be most sought after, because the altitude of machines will be reduced while they are ascending or when preparing to alight.

The aerial advertiser must tell his story in a very few words. One word, or perhaps two or three, will be all he can allow himself. Abroad, and more especially in America, the idea of aerial advertising is already attracting a good deal of attention. In New York, for example, there is at least one organization which specializes in this work. Over here, however, the advertiser has to remember that the air authorities, while quite sympathetic toward anything that is harmless, are at the same time exercising a very rigid and necessary supervision.

Another new field for business men who advertise will come when we have flying by night. This, as a matter of fact, will be the next important stage on the European airway system. Here again, of course, the advertiser will need to conform with the wishes of the authorities in regard to preventing his sign from clashing with any purely navigation light; but there should be no difficulty if common sense is used. There will be whole stretches of country, both here and abroad, over which aircraft will be passing in increasing numbers, and on which the advertiser will be able to place some illuminated sign so devised as to rivet the roving gaze of night travelers by air.

Apart from announcements on the earth on which voyagers look down from the air, there is the question of having an advertisement on an aircraft in flight so that those who remain on the earth may see and read it as the machine passes overhead. Here, at present, the smallness of commercial airplanes in use introduces a factor which is temporarily adverse. There is the point, furthermore, that the registration number has to be displayed prominently on each machine, which leaves less scope for advertising than would otherwise be the case.

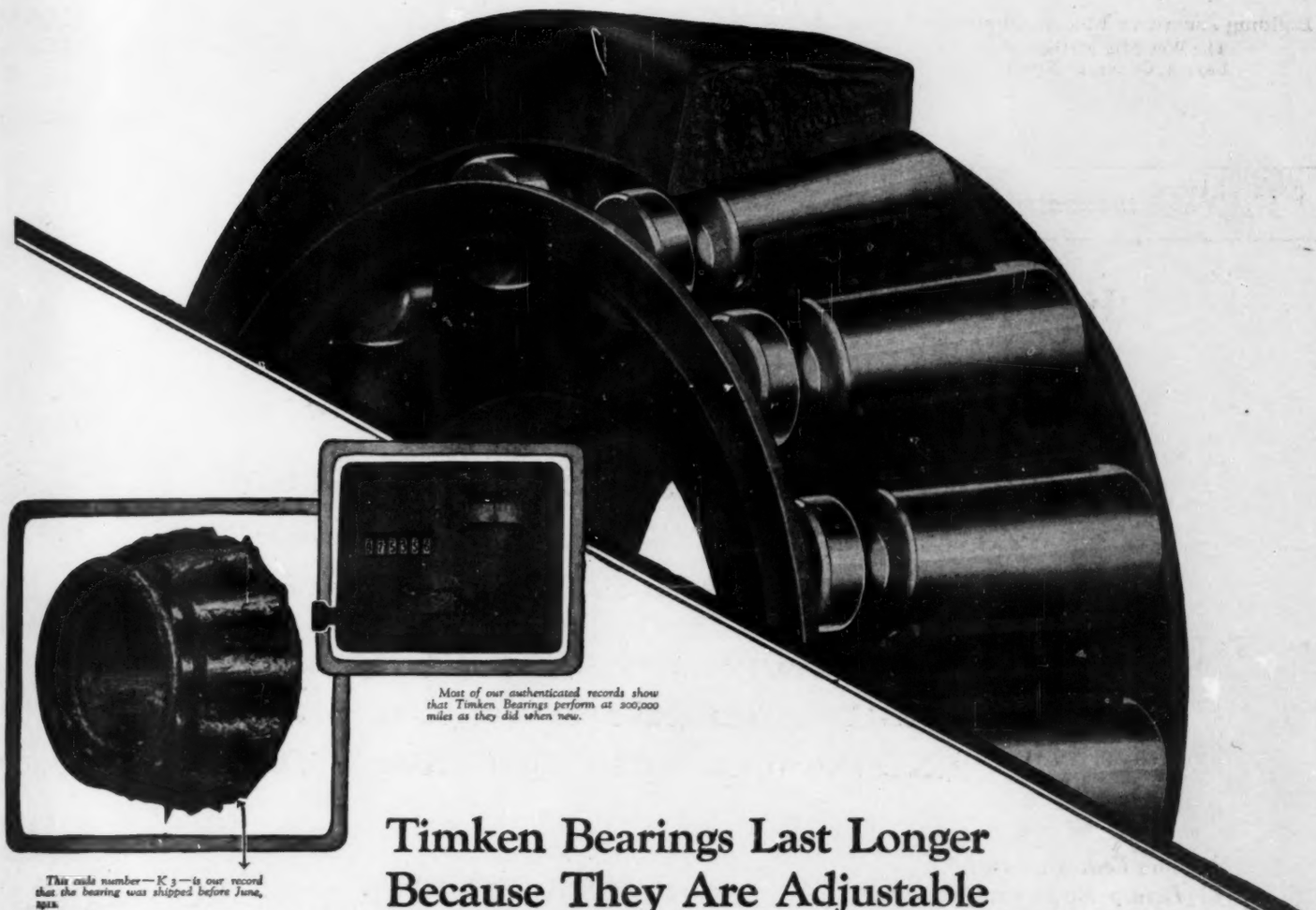
Where a field should lie, however, is in connection with large commercial airships. There will be ample space on their big hulls for advertising, and it may be assumed that companies operating them would not be adverse to obtaining revenue in this way, always granted that the advertisements are in good taste and placed on the hull with an eye to avoiding the incongruous.

Modern Research in an Ancient Industry

THE National Research Council and the American Ceramic Society have established a joint committee for promoting the investigation of scientific problems underlying the ceramic industry, especially by founding a series of research fellowships whose holders shall devote their attention exclusively to these problems.

The ceramic industries, including brick and tile making, and general crockery and glass manufacture as well as ornamental potteries, although among the earliest ones developed by man, have been the last of our great manufacturing industries to reach the status of an applied science. They have been based for centuries on rule-of-thumb methods, trade secrets and individual artistry. As far as their artistic features go science can do little or nothing for them, but in all other ways it can be of great advantage to them.

In sharp contrast to the painfully slow development of these ancient industries is the extraordinarily swift development of such exclusively modern industries as those of synthetic dyes and others entirely based on the discoveries of modern science. The startling success and speed of growth of these are almost entirely the fruit of highly organized scientific research, with methods of scientific control at young stage of the operations. A famous English scientist is authority for the statement that the capital, large as it has been, which the German dye firms have invested in scientific research has been the best-paying investment which the world has ever seen. It is certain that an organized effort to develop the fundamental science of ceramics can have a great influence in advancing the industry.



Most of our authenticated records show that Timken Bearings perform at 200,000 miles as they did when new.

This axle number—K 3—is our record that the bearing was shipped before June, 1911.

Timken Bearings Last Longer Because They Are Adjustable

Your milkman's truck—has it gone 1,000 or 200,000 miles; your doctor's passenger-utility car—is it in its first or eighth season; your farmer's tractor—has it worked one or three thousand acres!

Offhandedly this is no concern of yours. But when the doctor, the fireman, the milkman, the groceryman, the iceman, the coalman are delayed, you must realize the *vitalness* of good parts in automotive vehicles.

Of all the many good things users say about the 60,000,000 Timken Tapered Roller Bearings in heavy-duty operation, none means more than their enviable record of dependable performance.

Long life is inbuilt with their principle of *adjustability!*

That is why our files are full of

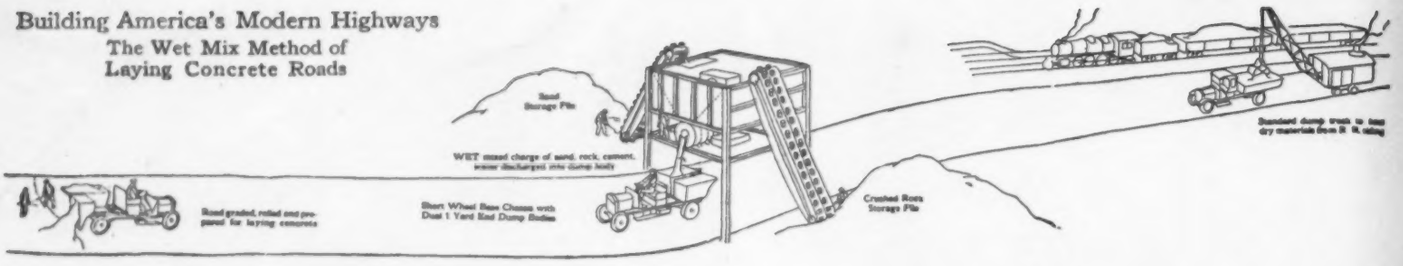
"—nine years and scrapped, but the Timkens were as good as new."

THE TIMKEN ROLLER BEARING CO, CANTON, O

Timken Tapered Roller Bearings for Passenger Cars, Trucks, Tractors, Trailers, Farm Implements, Machinery, and Industrial Appliances

TIMKEN *Tapered* ROLLER BEARINGS

Building America's Modern Highways
The Wet Mix Method of
Laying Concrete Roads



It takes more than mere mechanical ability to make a truck so pre-eminently successful as Federal

Equally as vital is an intimate first-hand knowledge of conditions under which each truck must operate

Federal engineers are not only trained automotive designers but thoroughly experienced transportation men

The Federal 2-Batch Dump Body in Use

The use of this new type of dump body has produced many striking economies in hauling both dry mix and wet aggregates between mixing plants and road bed on the highway jobs.

It is mounted on a special 2 to 2½ ton chassis with extra short wheel base to facilitate handling in confined places.

Another

FEDERAL

One to Seven Ton Capacities

Building America's Modern Highways
The Dry Mix Method of
Laying Concrete Roads